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THE FOUNDRY

THE PENTON
PUBLISHING COMPANY.

Cleveland | New York | Chicago | Pittsburg
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YOU can make large or small cores that won't blow or swell but will remain true to the pattern most successfully with

Peerless Dry Core Compound

When the castings come from the sand a few jars will make a core made with Peerless Dry Core Compound run from the casting like water.

Another advantage — Peerless Dry Core Compound can be used over and over again by simply renewing it a little.

Send for a trial barrel with full directions for use. Our experience in business for over 35 years has convinced us that Peerless Dry Core Compound is a big money and time saver.

Let Us Convince You.

The S. Obermayer Co.

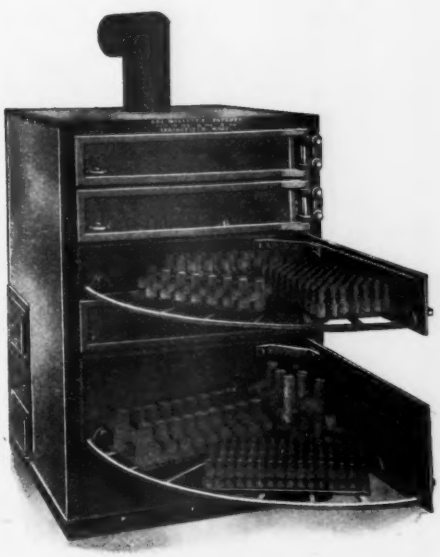
CINCINNATI CHICAGO PITTSBURG

"EVERYTHING YOU NEED IN YOUR FOUNDRY."

The Shortest Route to Core Room Success---

is through the Millett Core Oven. The best argument in its favor is the oven itself---giving continuous satisfaction. Compare it with the next best and you will see what we mean. It gives you perfect cores, when you want them, and is commended by users everywhere. Then there is its economy. Isn't the best at a saving in dollars and cents a conclusive argument for the progressive business man?

Millett Stationary Core Oven



Millett Portable Core Oven

THE MILLETT Core Oven Co.

Brightwood, Mass., U. S. A.

SALES AGENTS: S. Obermayer Co., Cincinnati and Chicago. J. W. Paxson Co., Philadelphia. J. W. Jackman & Co., London. J. S. McCormick Co., Pittsburg, Pa. Thomas W. Pangborn Co., 227 Fulton St., New York City.

FOUNDRY APPLIANCES

Simple—Durable—Reliable
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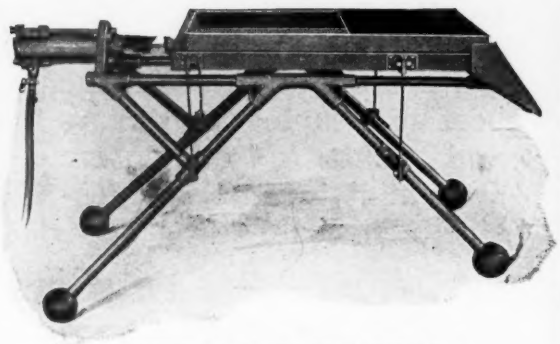
"Keller" and "Chicago" Sand Rammers.

Chicago Tripod Sand Sifter No. 1

"Boyer" "Keller" and Improved "D" Chipping HAMMERS
One hammer will do the work of from 5 to 8 men.

"Chicago" and "Keller" SAND RAMMERS are used by all modern foundries. They are fitted with stuffing boxes and hardened bushings to protect them against wear.



Chicago Self-Cleaning Sand Sifter No. 3

Sent on trial to responsible parties.

Send for catalogues and prices.

Manufactured by

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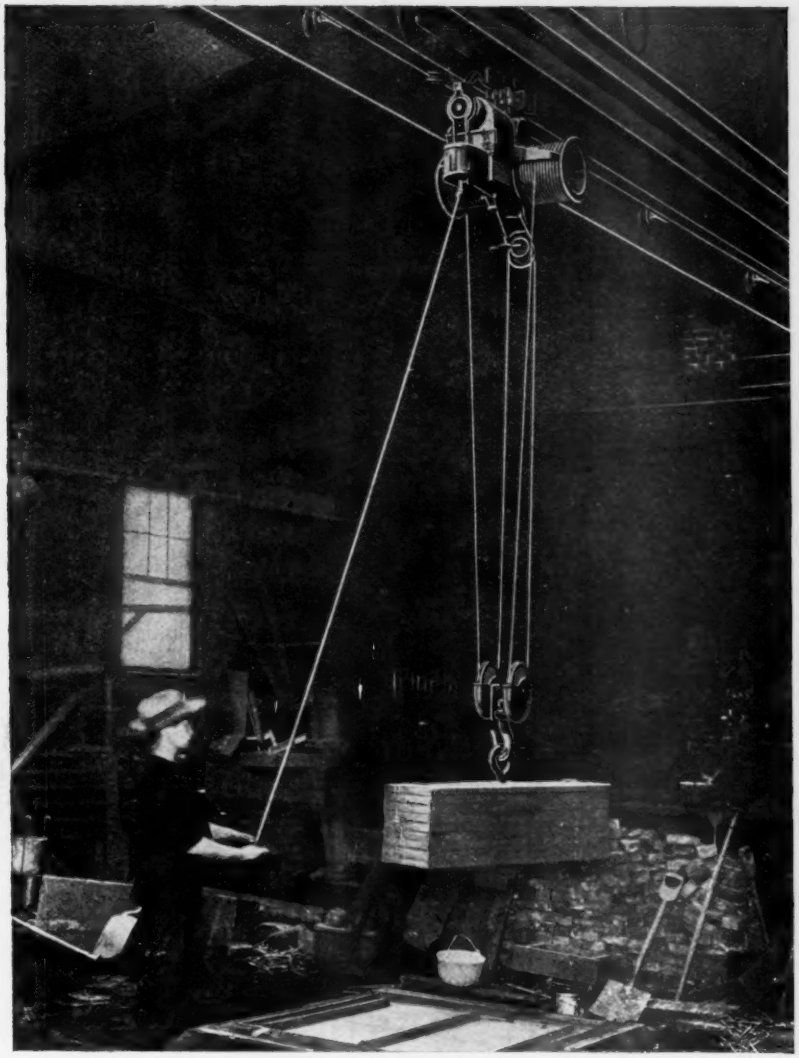
Branch offices everywhere.

Foreign representative, The Consolidated Pneumatic Tool Company, 9 Bridge Street, London.



A BOY CAN OPERATE THE Y. & T. ELECTRIC HOIST.

This shows a 4-ton Yale & Towne Electric Hoist installed on an old hand traveling crane. It has variable speed control and handles the most delicate foundry work. One to 30 tons capacity. Operates on voltages from 110 to 650 D. C. Write for catalog.

The Yale & Towne Manufacturing Co.

9 Murray Street, New York

FOREIGN WAREHOUSES: Fairbanks Co., London and Hamburg; Fenwick Freres and Co., Paris; Alfred H. Schütte, Köln a Rh.; F. W. Horne, Yokohama, Japan.

The Nice Crisp Greenback

That you are always so glad to get, in the future will be helped on its way to you by the Ridgway Steam-Hydraulic Elevator.

We have just been given the order by the United States Government for the equipping of the Bureau of Engraving and Printing with these wonderful elevators.

Had this splendid recognition of this great elevator come some years ago it would have set us away up high in the band wagon.

We are now getting so many orders from great establishments we don't feel as elated as we did at first. We have gotten kind a hardened to it!

Anyhow, that part of it is purely a personal matter that you have nothing to do with. The whole point for you is to know that nothing gets past a Government Engineer but what is the very best of its class.

The fact of the matter is, there is no language fit to print, strong enough to characterize the man who is fool enough to waste his money on any other kind of an elevator. Costs nothing to run, nothing to keep up, works fast; and is as gentle as an angel.

Uncle Sam and others are

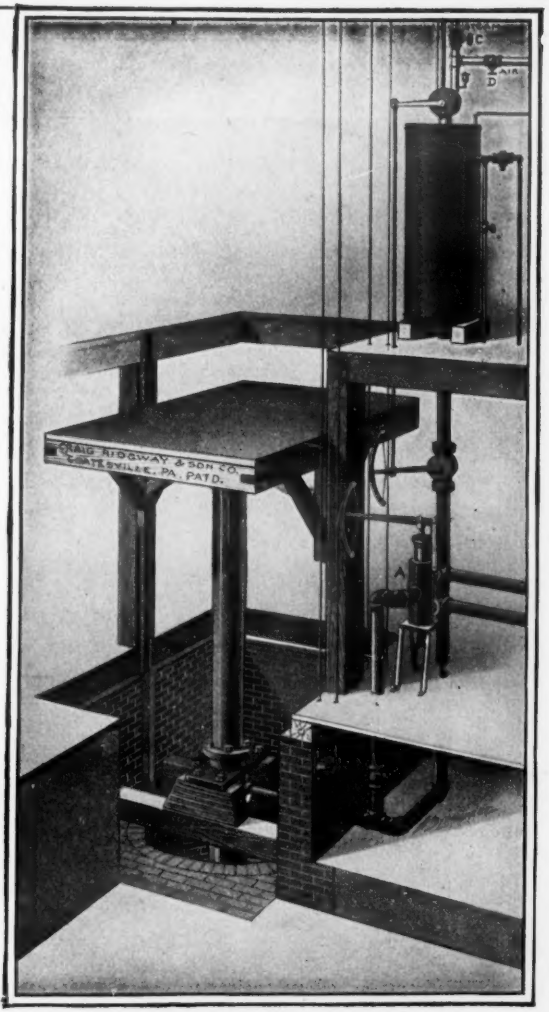
Getting from Under the Elevator Curse

and

Hook'er to the Biler

CRAIG RIDGWAY & SON CO.

Coatesville, Pa.



HANNA SHAKERS

for General Foundry Use

DON'T SCREEN YOUR SAND WITHOUT IT.

SMALL TRIPOD SHAKER

THIS type of machine is found very convenient and useful for general floor work on account of its portability and the fact that it will screen all the sand which one man can continuously shovel into it.

Hanna Engineering Works

820 Elston Ave., CHICAGO.

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Pneumatic Engineering Appliances Co. Ltd., Palace Chambers, Westminster, London Eng.

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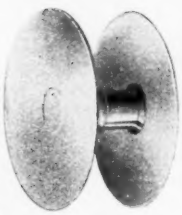
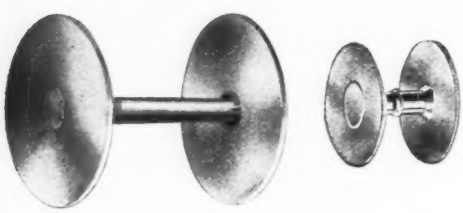
Lindsay Chaplets



A Short Story and Catalog of the popular Lindsay Chaplets. Let us send you one. A postal brings it.



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Harrison Building **Philadelphia**

NORTON GRINDING WHEELS

MADE OF

ALUNDUM

Meet the requirements for ALL kinds of grinding.

There is no investment that will pay a larger percentage of profit than a modern, up-to-date Grinding Department equipped with Norton Grinding Wheels and Grinding Machinery. Years of special study have given us the experience that will help us to help you.

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NEW YORK: 26 Cortland St., Havemeyer Bldg.
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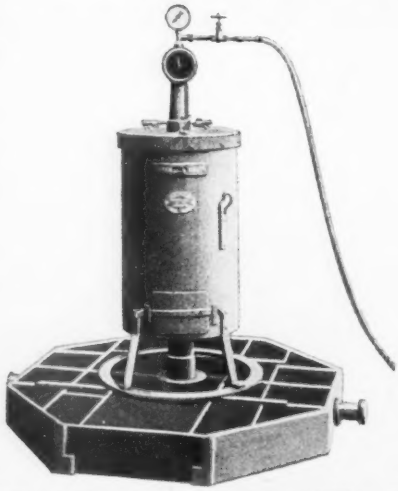
Send to nearest office for booklet "Made by the Powers of Niagara." 63

Patent Portable Mould Drier

A new device that is most economical and convenient for rapid drying of moulds.



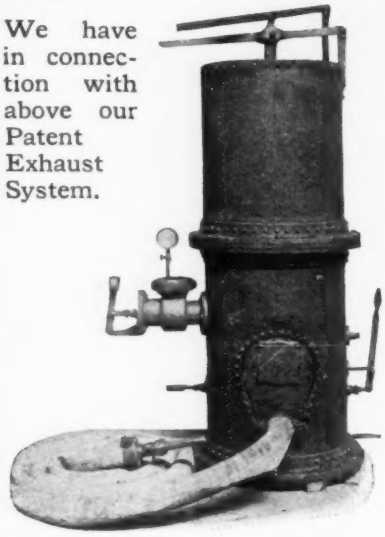
Simple in construction and operation—Can be easily handled by two men and quickly moved to any part of the foundry. The drier can always be kept ready for instant use.

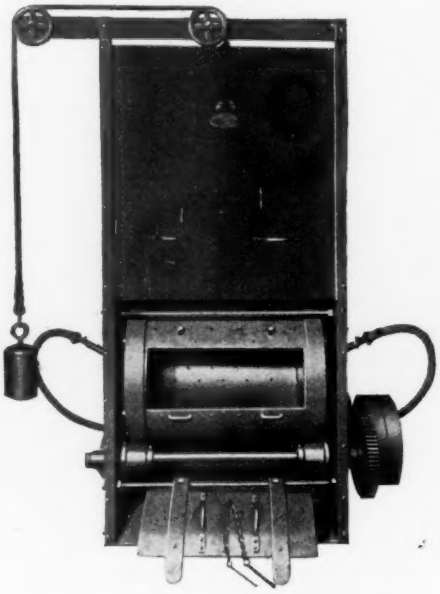
Write for illustrated circular A.

The Improved Sand Blast

cleans perfectly brass, iron and steel castings, removes all scale and gives a satin finish to the metal.

We have in connection with above our Patent Exhaust System.





SAND BLAST TUMBLING BARREL

for the rapid and thorough cleaning of small castings. To know this machine is to appreciate it.

Why Not Investigate.

Tilghman-Brooksbank Sand Blast Co. 1126 South 11th. St., PHILADELPHIA, PA.

We cordially invite the representative Brass Foundry interests of the country to a complete investigation of the advantages and merits of

The "Steele-Harvey"
CRUCIBLE BRASS MELTING FURNACE

over the old coke or coal method.

Our experience and knowledge of the interests of the Foundry has been based upon an experience commencing with the old way, and developing by degrees to the present, in connection with Oil or Natural Gas and Air. We do not claim **impossible** or **extraordinary** advances, but a development of the method of melting, which is **clean, economical, labor saving,** above ground, **no ashes,** or **waste** of metal therein, a **reduction** in **cost** of fuel, using that only **which is necessary to melt** a given quantity of metal, **one** furnace doing what **3** similar coke crucibles formerly accomplished. An honest machine, which if purchased will economize for cost value within a short time, **rapidity** of **melting**—reduction in **loss**—and extension in life of crucible—maintaining a **high quality** of **metal**

Our Standard

(Patented in the United States and all foreign countries.)

IN MELTING POSITION

IN POURING POSITION

When you want it—**"It is there with the goods." Do not hesitate,** but request one on **trial** and **approval,** and acceptance when satisfactorily demonstrated by our representative. On account of the enormous demand we have doubled our plant capacity and are in position to ship within 24 hours of receipt of order.

Built for capacities from **120** to **1,500** lbs. **per heat.**

Don't delay—"the other fellow will get ahead."

Write for Catalog.

The Monarch Engineering & Mfg. Co.

BALTIMORE, MD., U. S. A.

Works: Curtis Bay, Md.

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America's Best

We refer to iron---Cherry Valley Iron. A soft, strong and uniform quality for the foundry, obtained by careful selection of ores and closest attention at the furnaces. If you make machinery castings for particular people, Cherry Valley Iron is what you need. It's easy enough to be granted a small concession in price on an off-grade Iron, but you pay dearly for it in the end. Know, as hundreds of foundrymen do, those qualities that make famous the

Cherry Valley Iron.

Cherry Valley Iron Co.
Pittsburg, Pa.

William Sellers & Co., Incorp.

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Modern Machine Tools

We illustrate hereunder one of our specialties for Foundry use, which has proved very satisfactory and profitable in service.

Centrifugal Sand Mixing Machine

We have furnished these machines to many users and shall be pleased to supply full particulars upon application.

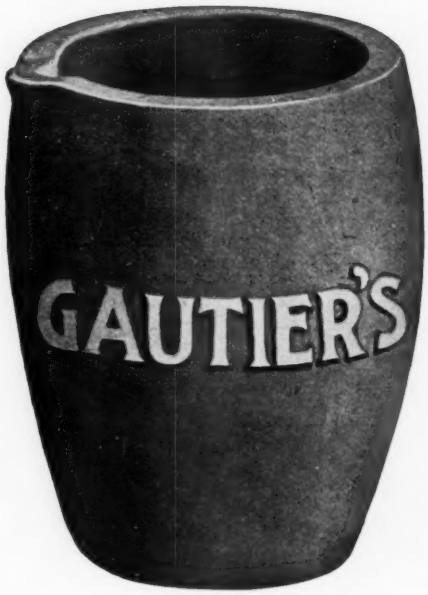
TRAVELING CRANES JIB CRANES

SHOP TURNTABLES

Improved Injectors for Boiler Service

SHAFTS, HANGERS, PULLEYS, COUPLINGS, Etc.

FOR THE TRANSMISSION OF POWER.



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J. H. Gautier & Co.

JERSEY CITY, N. J.

This trade mark stands for the acme of crucible uniformity

There's no guess work in the manufacture of a Taylor Crucible. Only the highest grades of material are used, and working strictly by our chemical analysis, we give a uniformity in the quality the year round, that is not approached.

A trial will convince you.

Robert J. Taylor, Incorporated

1900 to 1916 Callowhill Street

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The largest steel and brass manufacturers use McCullough-Dalzell Crucibles. They prefer them because they have been proved by actual test. Send us an order.

McCullough-Dalzell Crucible Co.

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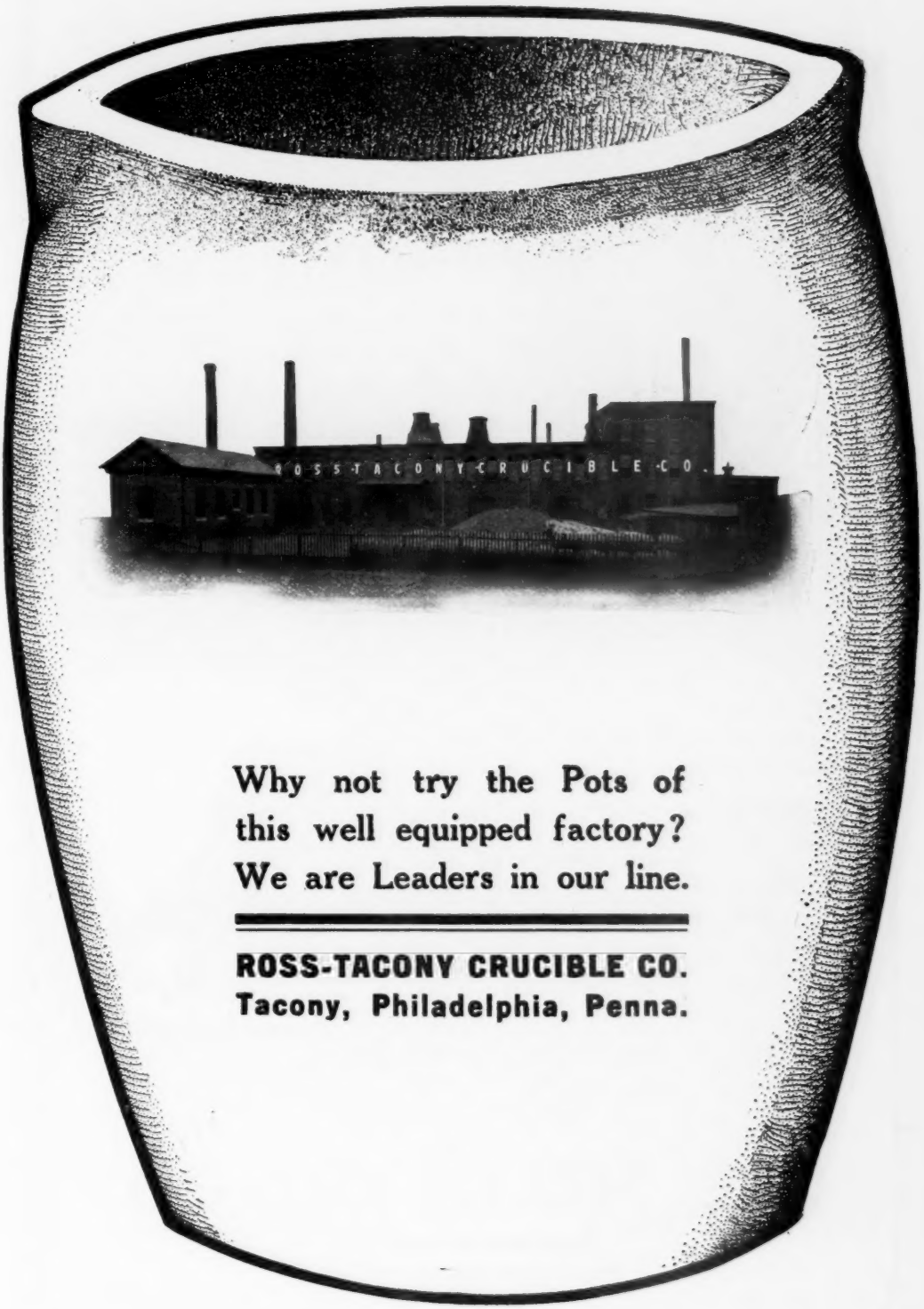

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ROSS-TACONY CRUCIBLE CO.
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C. E. Mills, Specialist

REFERENCES GIVEN TO THE LARGEST FOUNDRIES IN THE COUNTRY.

MILLS DRY CORE COMPOUND

No. 1 for heavy or ordinary Core-making No. 2 for any work, but is especially adapted for Malleable Iron, Brass and Steel Foundries. It goes three times as far as Rosin, and twice as far as Flour. No blow and no absorption of moisture.

SYRACUSE X-XX-XXX CORE OILS

Perfect adaptation for all work. Best Core Oil on the market.

SYRACUSE LADELENE COMPOUND

Facing, Core Wash, Lining for Ladles, Cupolas, Locomotive and Stationery Fire Boxes, Gas Work, etc.

Half the cost making cores with our MILLS DRY CORE COMPOUND.

We have Agencies in the following cities, who carry our goods in stock, whose territories are as specified:

GOLDEN RULE OIL CO., 171 Washington St., Chicago, Ill.
Agents, Cooke County, Illinois, and State of Iowa.

HILL & GRIFFITH CO., Cincinnati, O.
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WHITEHEAD BROS. CO., Providence, R. I.
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THE DOMINION FOUNDRY SUPPLY CO., Ltd., Agents for Canada.
Offices and Warehouses—122 Wellington St., Toronto, Ont.
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GLUTRIN

A LIQUID ADHESIVE CORE SAND BINDER

¶ Will make uniformly better cores---and at a lower cost—than any other material offered for the same purpose.

¶ And this; the lower cost is not solely because of its small price per gallon, but by reason of other savings. May we write you about them?

¶ Sold in tank cars or barrels---the latter containing from 50 to 53 gallons each.

¶ Our stencilled brand and weights are a guarantee of the quality and of the quantity on the basis of the exact weight--10½ pounds to each gallon.

ROBESON PROCESS CO.

CAMDEN, N. J., U. S. A.

¶ GLUTRIN CORE BINDER is carried in stock and sold by *THE S. OBERMAYER COMPANY* from their houses in *Cincinnati, Chicago, Pittsburg and St. Louis.*

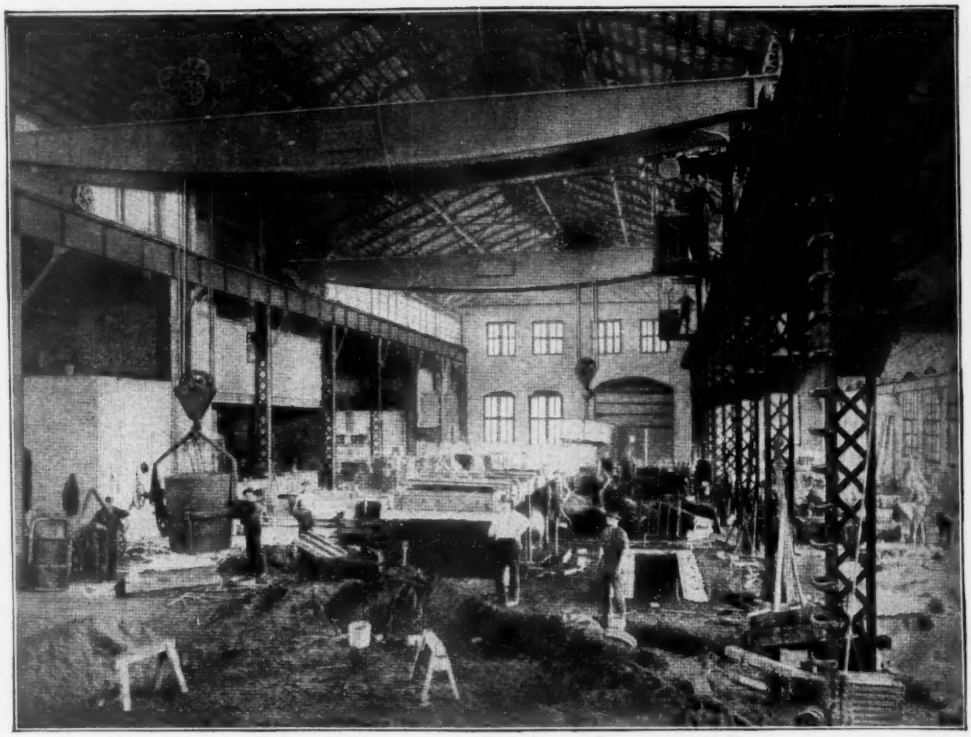
¶ GLUTRIN CORE BINDER is carried in stock and sold by the *HAMILTON FACING MILL CO.* from their houses at *Hamilton, Ontario, and Montreal, Quebec, Canada.*

¶ GLUTRIN CORE BINDER is carried in stock and sold by the *ROBESON PROCESS COMPANY* from their factories in *Camden, New Jersey, and Au Sable Forks, New York.*

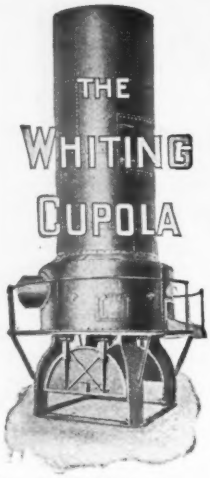
WHITING FOUNDRY EQUIPMENT CO.

General Office and Works, HARVEY, ILL., U. S. A. (Chicago Suburb)

Engineers Designers Manufacturers



Two Three-Motor Electric Traveling Cranes, capacity twenty tons. Bates Machine Co., Joliet, Ill.



Cupola, 2000 in use.

ELECTRIC TRAVELERS
CRANES OF ALL TYPES

Cupolas and **Machinery** for **Complete equipment** of **Foundry Plants. Contracts taken covering buildings** and **entire Installations. Inquiries Solicited.**

Have you our Catalogs? If not, send for them. Tell us about your Foundry Plans—we may be able to assist you.

THE FOUNDRY

Vol. 30, No. 1. *CLEVELAND, OHIO, MARCH, 1907.* *Whole No. 175*

A MODERN GREY IRON FOUNDRY.

New Plant of the Babcock & Wilcox Co., Barberton, O.—Novel Features of Design and Construction.—A Few Unique Molding Methods.

THE Babcock & Wilcox Co., New York, manufacturer of water tube boilers, in merging its Mansfield, O., works with its Stirling department, Barberton, O., has made extensions to the latter plant which will practically double its output. One of the numerous additions is a grey iron foundry having sufficient capacity to produce all the castings required by the other departments, and which not only embodies many novel features in design, but in the appliances for handling the raw materials as well.

In designing the foundry, the main bay of which is shown in Fig. 1, the economical conveyance of such supplies as pig iron, coke and scrap, from the foundry yard to the charging floor, received as careful consideration as the arrangement of the cupolas and molding floors. Elaborate provisions were also made for storing sand, and as shown in the ground plan, Fig. 2, the auxiliary buildings containing the brass foundry, core department, wash rooms and sand mixer, are conveniently located.

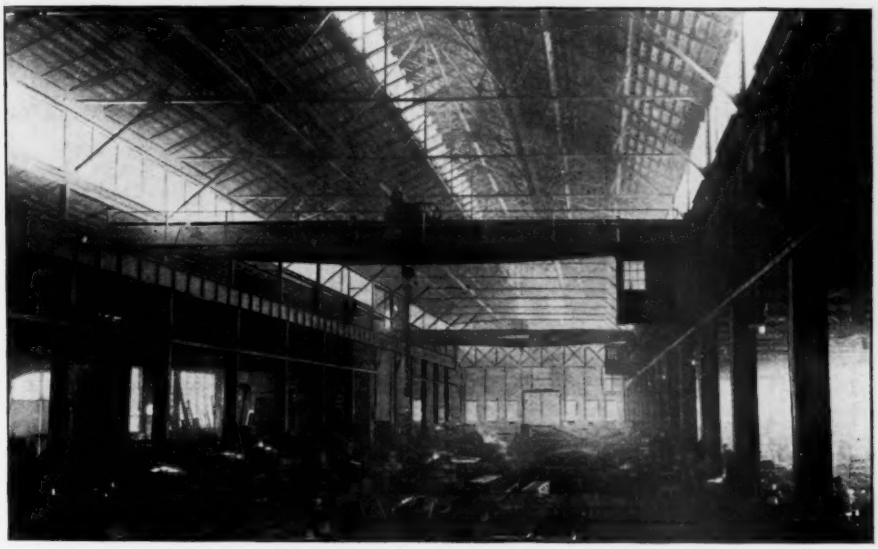


FIG. 1.—GENERAL VIEW OF BABCOCK & WILCOX CO.'S FOUNDRY, BARBERTON, O.

The Foundry.

The main building is 500 x 132 feet, of steel construction, with brick curtain walls. The central bay, in which the heavier floor work is made, is 58 feet 5 inches wide, and is commanded throughout its entire length by two electric travelers of 10 tons capacity each, installed by the Niles-Bement-Pond Co., New York. The lean-tos are each 35 feet

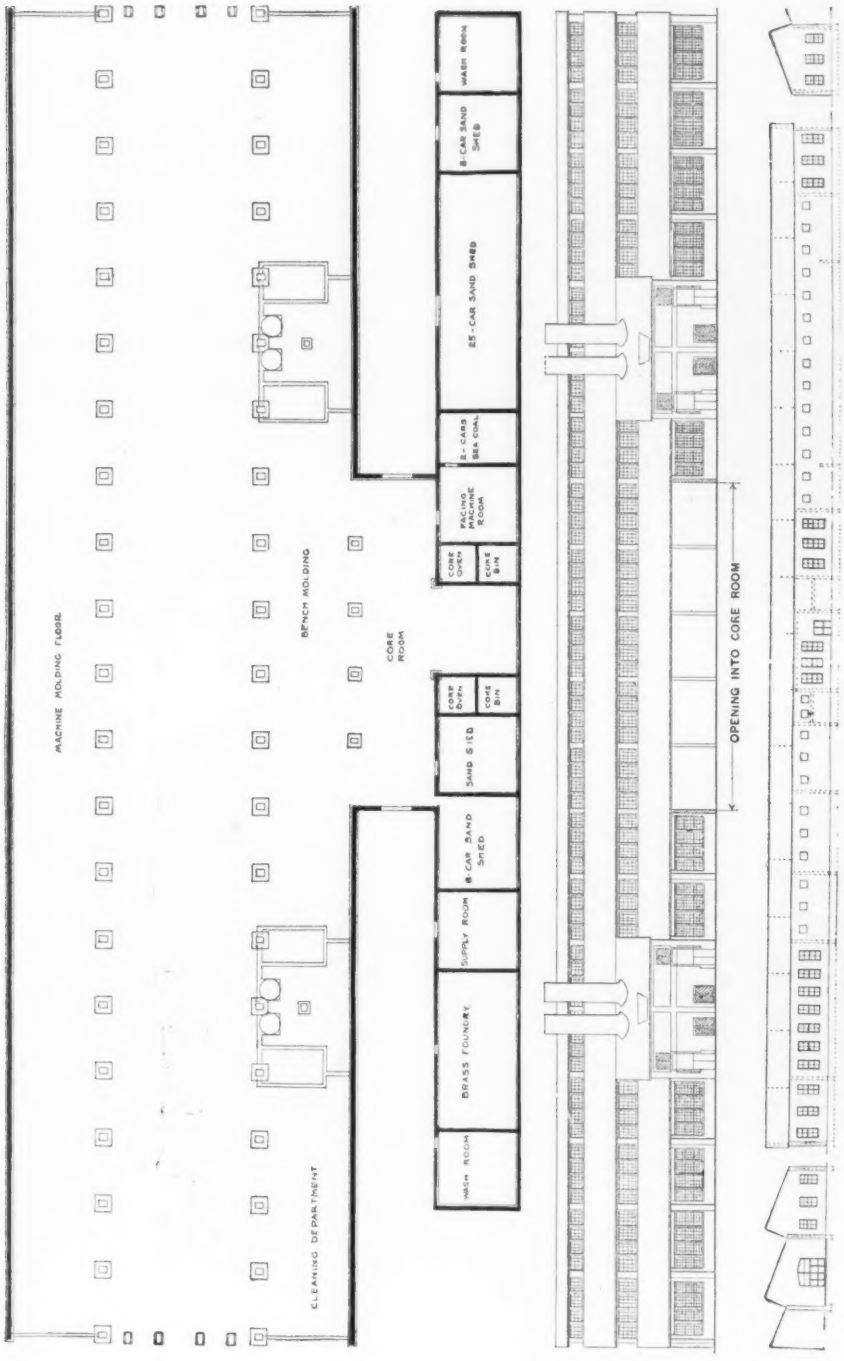


FIG. 2.—GROUND PLAN AND SIDE ELEVATIONS OF FOUNDRY AND AUXILIARY BUILDINGS.

wide, the one shown in Fig. 3 being devoted entirely to machine molding. In the lean-to on the opposite side are located the cupolas, cleaning and bench molding departments, as well as a floor for smaller castings. The building is

FIG. 3.—MACHINE MOLDING FLOOR.

well lighted and ventilated. The top row of ventilator windows which extend its entire length are 5 feet high, and as the distance from the floor level to the peak of the structure is 60 feet, gases and smoke generated while pouring off are rapidly carried away. Intermediate rows of side lights also extend the length of the lean-tos, and the natural illumination is such that the use of artificial light, even on the darkest days, is entirely obviated. Arc lamps have, however, been provided for night operations. A height of 25 feet to the top of the crane rail insures ample head room, in the center span, while the building is 37 feet high to the under side of the main roof truss. To permit of the use of the travelers on a crane runway extending into the yard, if desired, swinging doors have been placed in both ends of the building through which the cranes can operate and carry their loads. Similar arrangements have been made in the buildings of some of the other departments to permit of the loading and unloading of cars outside of the shops.

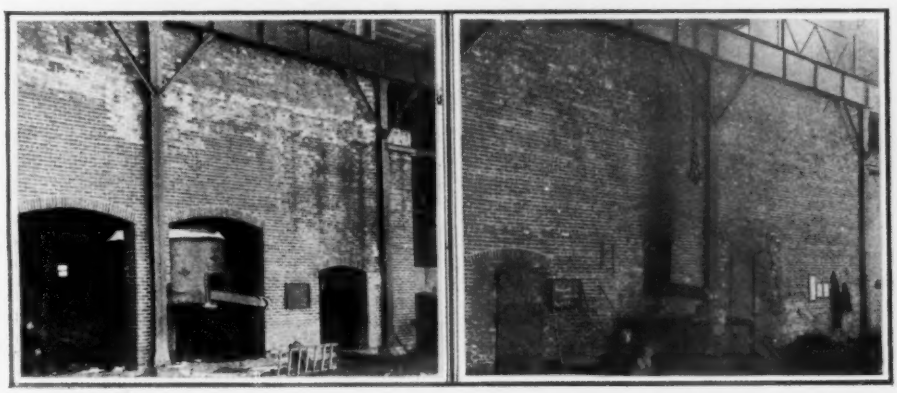
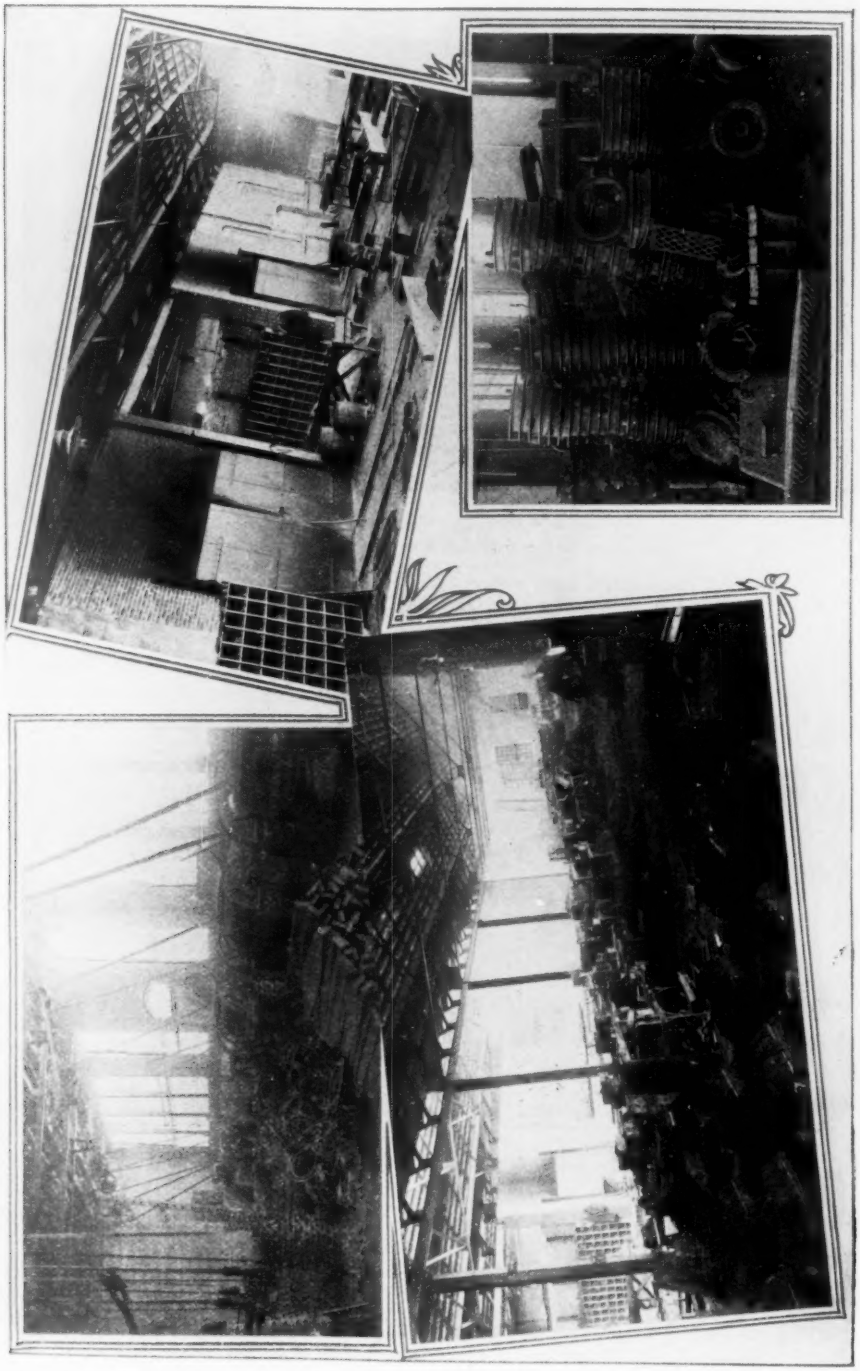


FIG. 4.—THE CUPOLAS.

Cupolas.

Although only two cupolas have been installed, provisions have been made for four. The furnace rooms, Fig. 4, are located in one lean-to, and to reduce to

the minimum the distance which the iron has to be carried, they are placed midway, one-half the length of the foundry. These rooms are divided from the remainder of the departments by brick walls, and brick curtain walls separate the blower rooms from the cupolas, the blast pipes being carried through the



Core Department.
Some of the Product.

Fig. 5.

Cleaning Department.
Bench Molding Floor.

brick walls. As the blower rooms are entirely enclosed, they are practically free from the dust and sparks which shorten the periods of usefulness of equipment unnecessarily exposed. The two cupolas have a diameter of 66 inches inside the lining, and were installed by the Whiting Foundry Equipment Co., Harvey, Ill. The blast pipes, which are 21 inches in diameter, are connected with the cupolas in almost a straight line and have only a slight bend where they connect with the discharge of the blowers. Air is furnished by two No. 6 blowers installed by the Piqua Blower Co., Piqua, O., and the Connersville Blower Co., Connersville, Ind., respectively. They are direct connected to 55-horsepower motors installed by the General Electric Co., Schenectady, N. Y., and their speed can be regulated and maintained as required by controllers furnished by the Cutler-Hammer Mfg. Co., Milwaukee. The two cupola rooms are each 58 x 35 feet, and the four blower rooms 16 x 25 feet.

Charging Floors.

The charging floors each have an area of 74 x 60 feet, and have been raised to a height of 17 feet above the foundry floor. Coke, iron and scrap are elevated to this floor by means of a gantry crane, the charging buggies being deposited on the platforms erected outside of the building on a level with the charging floors. For the movement of the buggies an industrial track system has been installed, equipped with tables for the turning of the cars. The buggies are received on the charging floor on one platform, and after the material has been unloaded they are pushed on to the other platform, from which they are lowered to the yard by the crane. This continuous movement precludes the accumulation of material on this floor while a heat is being run. Each buggy carries a charge of 4,000 pounds, the charges being made up and weighed in the yard. The coke bins have a storage capacity of about 40 tons, and are built with steel plate sides. The floors of the bins, as well as the floor of the remainder of these departments, are made of cement. Coke is delivered through openings in the roof, as shown in the side elevation, Fig. 2, from a clam shell bucket depending from the gantry crane. This method of conveying the coke from the yard, in addition to its novelty, has greatly reduced the cost of handling and the breakage of this material as well. These openings are provided with sliding doors, which are closed in inclement weather, thus keeping the coke entirely under cover, and can be opened for ventilation when desired. Two hydraulic elevators have also been provided for each charging floor, but are only used in emergencies and in the event of a breakdown of the yard crane. Such large sections as boiler fronts, fire door panels, columns and heavy castings generally are made on the floor in the main bay, and fire, cleaning, and inspection doors and frames are made on molding machines in one of the lean-tos. The equipment of this floor consists of nine machines of the stripping plate type, as well as several of the roll-over design installed by the Tabor Mfg. Co., Philadelphia.

Core Department.

The bench molding floor, shown in Fig. 5, is located between the cupola rooms, and the core department, part of which is devoted to the storage of current patterns, is located in a lean-to on the west side of the building and is 125 x 30 feet in dimensions. This building opens into the bench molding department, and provides for the easy delivery of patterns and cores to the various floors. In design, it differs from the main structure, having concrete walls 18 inches at the base, and a height of 17 feet to the gable. The roof is of the saw-tooth type and has a row of windows set at an angle of 15 degrees in the trusses of the east side. Opening into the core room is another building, 30 x 450 feet, in which the core ovens are located. This equipment consists of two Millett ovens, installed by the Millett Core Oven Co., Brightwood, Mass., in which the smaller cores are dried, and two large ovens which are coke fired from the outside, respectively 20 x 13½ feet and 15 x 13½ feet. The larger cores are baked in these ovens on rack buggies, which operate on tracks extending into the

core room. Shelves have also been arranged on one side of these ovens, on which some of the small cores are dried on plates, which materially increases the drying capacity.

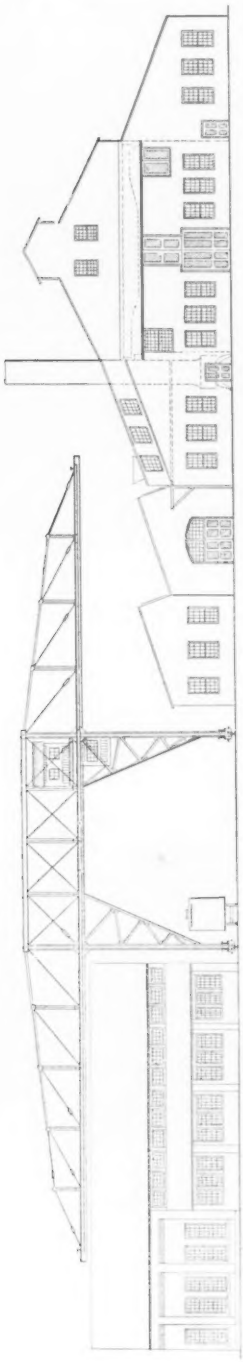


FIG. 6.—YARD CRANE WHICH SERVES FOUNDRY AND MACHINE SHOP.

Sand Sheds.

The sand sheds and facing machine room in this building open into the foundry through the core department. This structure has a saw-tooth roof, concrete walls, and concrete partitions separate the different departments. The wash rooms are located at either end are 30 feet square. They are provided with enameled basins, hot and cold running water, and other conveniences for the welfare of the workmen. The brass foundry, which has not yet been equipped, occupies a space 60 x 30 feet, and the room in which the smaller foundry supplies are carried is 30 x 30 feet. The sand sheds for the storage of the various grades are respectively 35 x 30 feet, 45 x 30 feet, 30 x 30 feet, and 90 x 30 feet, and have a combined capacity of 43 cars. The sea coal storage department is 20 x 30 feet, and has a storage capacity of two cars. The sand is delivered to the sheds through openings in the roof from a clam shell bucket operated by a gantry crane and is unloaded from the car in a similar manner.

Cleaning Department.

The cleaning department is located at one end of a lean-to of the main building, and is equipped with four tumbling barrels, three pedestal and three swinging grinders, all operated from one shaft, driven by a 25-horsepower General Electric motor. The larger sections are cleaned on the floor at this end of the foundry, and the castings are delivered to the machine shop on a large flat car, which operates on a standard gauge track extending across this end of the building. This reduces the cost of handling to the minimum and also provides for direct communication between these two departments. At the other end of this lean-to is another floor molding department, which will be devoted to special work.

Gantry Crane.

The gantry crane, shown in Figs. 6 and 7, which operates between the foundry group and the machine shop, is used for unloading pig iron from the cars by

means of a magnet, for the delivery of coke from the coke pile to the charging floor, and for unloading sand from cars and carrying the same to the sand sheds. In addition, it raises the buggies containing the charges of pig iron and scrap, the track is 45 feet, and the distance to the top of the bridge is 62 feet. The electric current is taken from the conductor rail on either side of the rails on which the bridge travels. The bridge travel is at the rate of 325 feet per minute,

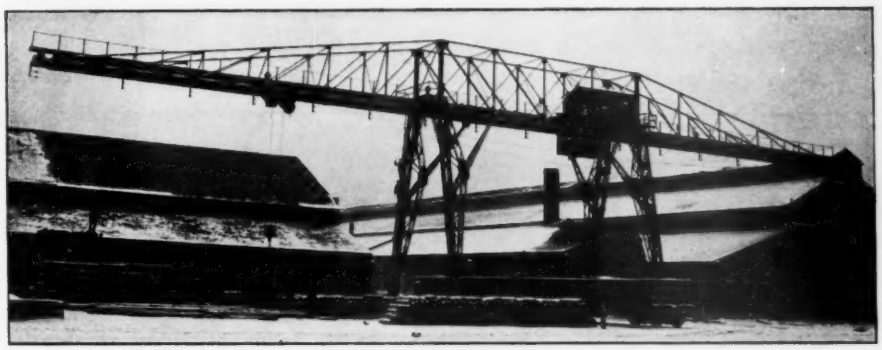


FIG. 7.—YARD CRANE.

which are made up in the yard, to the platforms outside of the charging door, and likewise lowers these buggies to the ground. Incoming material is received on cars which operate on tracks underneath the center span, and the crane has sufficient travel to cover the flask yard of the foundry. It has a length over hoist 35 feet per minute, and the ultimate limit of the trolley 200 feet per minute. In addition to serving the foundry and the machine shop, the crane is used for stacking castings in the yard and for unloading tubes for the various storage sheds. One man controls the operation of the crane, as well as the trolley. It

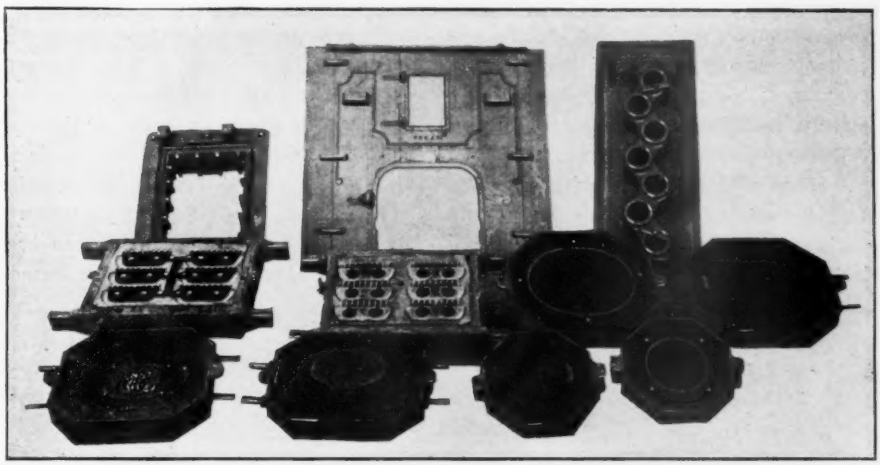


FIG. 8.—MISCELLANEOUS MOLDS AND PATTERNS.

all of 225 feet and a center span of 60 feet. The east arm, over the foundry, is 76 feet long, and the west arm, which extends over the machine room, is 89 feet long. The trolley has a capacity of six tons. The height of the bridge from was built by the Variety Iron Works, Cleveland.

Methods of Molding.

For molding some of the cast sections which include only such accessories as fronts, panels, columns, fire, cleaning

and inspection doors and frames, grate bars, chain grate links, shoes, saddles, etc., several novel methods have been evolved, which not only facilitate operations, but likewise have reduced the cost of production. Six of the molds for links for chain grates, Fig. 8, are made in a flask, the pattern being mounted on a follow board. Steel cores are used in the place of dry sand and are coated with a special preparation which permits them to be easily knocked out of the casting. These cores leave a clean hole for the bar on which the links are mounted, and the cost of machining has thereby been entirely eliminated. In addition, the hole is slightly chilled, which is desirable in a casting of this kind.

Inspection doors for mechanical stokers are recessed for asbestos gaskets, the recesses being made by means of tapered dry sand cores, Fig. 9, of circular form made in four sections. The elliptical cleaning doors are also recessed for asbestos gaskets, the cores being merely pressed into the print. When this mold is made on a floor, the recess is made in the cope, and the core is nailed into place. When made on the molding machines, the recessed side is in the drag, and as the core only has to be pressed into the print, all nailing is obviated. The latter method not only increases the daily output, but likewise effects a saving in cores.

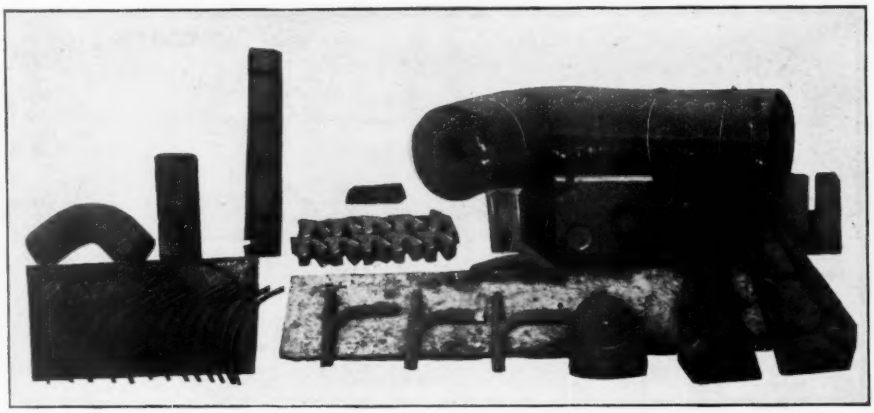
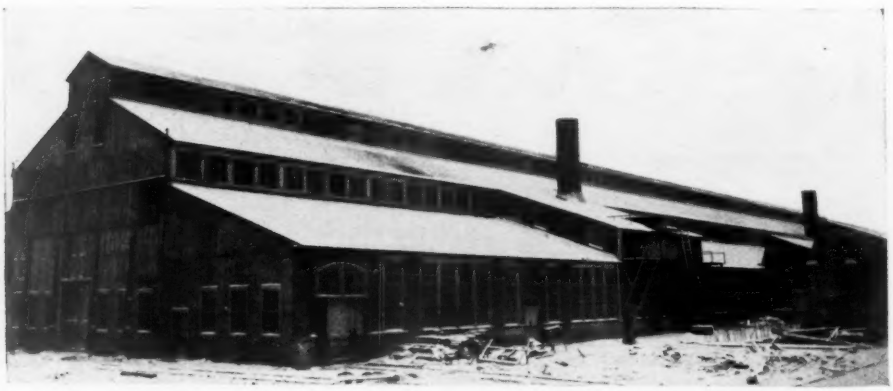


FIG. 9.—SOME OF THE DIFFICULT CORES.

In making the molds for the herring bone grate bars up to a size of 4 feet 6 inches, two patterns are made in a flask, the pattern resting entirely in the drag. Those over 4 feet 6 inches are made one in a flask and all molds are gated at both ends that the pouring of the iron may proceed slowly, so as not to break down the smaller sections of the mold.



TECHNICAL FOUNDRY EDUCATION.*

Courses of many Schools too Elementary—Antiquated Methods Taught—New Course Suggested Which will Specialize in Foundry Practice.

By H. E. Field.

"Any candid observer of the phenomena of modern society will readily admit that bores must be classed among the enemies of the human race and a little consideration will probably lead him to further admission that no species of that extensive genius of noxious creatures is more objectionable than the educational bore. Convinced as I am of the truth of this great social generalization, it is not without a certain trepidation that I venture to address you on an educational topic."

This quotation from that great authority on education, Huxley, expresses in a terse way my hesitancy in bringing to your attention this subject of education. Recent assertions by prominent foundrymen confirm my belief that this subject is of vital importance to the foundry industry at the present time. President West, of the American Foundrymen's Association, and President Pilkington, of the British Foundrymen's Association made education a key note in their presidential addresses.

President Hadfield, of the Iron and Steel Institute, in his presidential address says: "There is also need for the education of foundrymen. This side of technical industry has hitherto been relegated far too much to chance. No one wishes to decry the value of experience, but there is no reason why foundry managers and foremen should not occupy a position equal to that of the mechanical engineer. Facilities should be given to foundrymen to study the principles of their craft at technical schools and in other ways they should be led to acquire a sound theoretical training and not merely rudiments of practical knowledge."

The American Foundrymen's Association, the National Foundrymen's Association and the trade journals have given attention to the subject. It is a live topic in which every foundryman should be interested; not with a prospect of immediate results, but with an eye to the future when we should have a corps of trained men graduating from our technical schools equipped to intelligently solve the problems of our foundries.

Let us for a few moments examine the present status of our colleges and technical schools and consider their defects as a basis for future improvement.

The only method by which to determine the efficiency of an industrial plant is by studying its output and so, if we would judge our modern educational institutions, we must consider their graduates. In doing so we are reminded of the words of Herbert Spencer when speaking of the graduate and his education. "In his shop, or his office, in managing his estate or his family, in playing his part as a director of a bank, or a railway, he is very little aided by this knowledge he took so many years to acquire—so little that generally the greater part of it drops out of his memory."

This may appear severe when applied to the conditions of today. There are, however, many indications that this statement is not an exaggeration.

Employers are continually protesting against the non-preparation of graduates for a practical business life. In reply the colleges may point with pride to the achievements of their

*Read before the New England Foundrymen's Association December 12.

graduates in the commercial and industrial world. This apparent contradiction may be readily explained. The average college turns the graduate adrift possessed with a smattering of languages, history, economics, mathematics and science which his future employer finds an imperfect equipment. Coincident with this potpourri of knowledge, the graduate has acquired an ambition to succeed together with a knowledge of how to think. These two qualities, ambition and an ability to think or reason, account for the success of 90 per cent of the college graduates whose advancement has depended upon their own efforts. Valuable as these two qualities are, it would appear that together with them the student could be given a more practical education to aid him in his future vocation.

This subject was capably considered by Mr. Fred W. Taylor, president of the American Society of Mechanical Engineers, in his recent address given at the dedication of the engineering building of the University of Pennsylvania. The following remarks by Mr. Taylor on education from the standpoint of a successful employer should carry weight and deserve careful study. "Within a few years after graduating the college educated engineer far outstrips in position and salary his average competitor who comes up from the ranks." Mr. Taylor emphasizes, "Within a few years" and calls attention to the fact that as a rule the graduate spends the first few years in a state of discontent and unrest, and does not become of real value to himself or to his employer until he has lived down these feelings. He cites as an example one concern which gives the following preference in employing men for certain positions: First, technical graduate; second, college graduate, but employs no college graduate who has not been out at least two years.

These statements together with hundreds of others which might be brought before you show that while our colleges are doing a good work their output is somewhat defective. I do not for a moment wish to decry the value of higher education. I do wish to consider with you and interest you in its defects with the hope that some remedy may be evolved. The first point which I bring before you concerns the selection of the proper institution and courses to fit one for a future work.

Selection of Schools and Courses.

It is not sufficiently appreciated that an entirely different training is necessary to fit one for a professional life from that required to equip one for an industrial occupation. As Spencer says, "If we enquire what is the real motive for giving a boy a classical education we find it to be simply conformity to public opinion. Men dress their children's minds as they do their bodies, in the prevailing fashion."

Is this not true today? Do not temporary surroundings, sentiment and local conditions frequently exert too great an influence on the course of the young student? Do not you as employers of graduates frequently complain of the inadequacy of education as a training for practical work and then allow your son to be guided by the fact that his class mates are going to this or that college, and so he, drifting with the tide, adds one more for you or some other employer to be disappointed in, while he for himself enters his life occupation with a handicap which might have been avoided had you with your greater experience and wider range of vision exerted your influence towards guiding him to a course which might have aided him in his future work.

The parents are not wholly to blame for the lack of assistance given to students in selecting proper courses for study. The modern trend in education is towards giving the student a freer hand in selecting his studies, in other words, an increasing number of subjects are being made optional. This tendency has its good features, also its bad ones. The student is in a formative period and his ideas are neither established nor crystalized. It

is the important time of his life in many ways. His selection of subjects determines to a great extent his success or failure in his future occupation, and yet, momentous as this step is, the final decision is often made by the student with no experience to aid him. Mr. Taylor emphasizes the fact that all decisions of consequence in commercial and manufacturing concerns are made by specially trained men. He rightly contends that trained men should select for the student those branches of learning which would be of most value to him in his chosen vocation.

If you in your foundries were continually turning out a defective product, would you be contented with complaining about it? No; you would ascertain the cause and remedy it. It is not sufficient for us to grumble about these defects in the selection of subjects; it is necessary that we assist with advice those who are electing courses of study and urge upon our schools and colleges the necessity of engaging men qualified by practical experience to aid the student in adopting his curriculum.

It is interesting to note that an effort along this line is being made by one of our prominent technical schools. If the student, after a sufficient probation period, does not show an aptitude for the course which he has chosen, he is recommended to some other and thus a good engineer will not be spoiled to make a poor chemist, and vice versa.

Relative Value of Subjects Studied.

The relative value of each subject should be carefully considered in making up a course of study. At present too much of the student's time is often proscribed or elected to subjects which, while important, consume a portion of his attention greatly in excess of their merit.

The tendency towards specialization is a characteristic, almost a mania, of this generation. This perhaps is to be regretted, but it would appear advisable to emphasize those branches which will best fit one for the work which he is to do and give less time to those of less relative importance.

As an example, the memory and capacity for learning are both increased by studying languages, but if these languages are to prove of no real value to the student in the years to come, the fact that they cultivate the memory is not of sufficient importance to warrant the employment of the student's time at the expense of some other branch which will be of greater future benefit. The study of science gives to the student an even greater opportunity for cultivating the memory and in addition there accrues an improvement of the reasoning power and a knowledge of cause and effect. Science is built upon fixed laws which can be understood only by exerting the reason.

As previously stated, the chief advantage which the college graduate has over the non-graduate is his ability to think or reason. If this is his leading asset, would it not be wise to cultivate it by awarding greater prominence to those subjects which lead him to think or reason? This phase will be more appreciated as we come to realize that it is not what is learned, but how it is learned, or as one writer puts it, "We should not attempt to make mental store houses of the students, but mental factories."

Newton said that his success was not due to the fact that he was smarter than other people, but that he thought more. Postalozzi, the famous Swiss educator, observes that "Education as the acquiring of information is one thing; it is quite another to develop the human force of a thoughtfully planned course of training mentally, physically and morally, fitting the student for a complete living." Too much emphasis cannot be placed on this phase of education. The mind of the student should be developed for his future work; it should be trained to think and to originate, not simply to acquire. The engineer is not employed for his knowledge of past achievements, but for his creative power.

Value of Industrial Discipline.

Upon examining our product, the graduate, through the eyes of the employer, we find one more glaring fault, viz., a lack of appreciation of the practical and commercial side of business life. This leads to the feeling of discontent

and unrest mentioned by Mr Taylor. Mr. Taylor suggests as a remedy that the student before graduation be obliged to spend one year at a manufacturing plant and there come in contact with his fellow men upon a practical working basis. This would give him a correct understanding of actual industrial conditions. His solution would without doubt be an ideal one. It is, however, infeasible owing to obvious disadvantages, both from the standpoint of the educational institution and from the standpoint of the manufacturer. It would appear to be more practicable for the educational institution to change its methods in general and the manufacturing establishments to convert their shops into educational institutions. Would it not be better to surround the student in the educational institution with conditions parallel to those he is to encounter in actual work, embracing discipline as to hours, responsibilities, etc.?

The problem of the educational institution is to graduate a student with sufficiently developed practical ideas to enable him to take his place at once as a producing factor in our manufacturing plants. In order to do this the student must be given a practical idea of manufacturing life in general and have impressed upon him the responsibilities of his future work He should be subject to a discipline which will coincide with that of actual work. The conditions which surround the average college education do not tend toward this end. The requirements of a manufacturing plant are very different from those of the majority of professions, consequently the conditions which surround the student in preparation for a manufacturing career must be different from those surrounding students whose future is to be a professional one. I believe that a student deciding upon an industrial career should from that minute apprentice himself, as it were, to that career. He should forego the pleasures of a college life and enter upon his course of study, not as a mixture of pleasure and work, but as a period of work. The attempt to combine the "college life" of the classical university with the strenuous application necessary in the technical school, has never been a marked success Our technical schools could become institutions with the regular regime of the industrial establishment. The student should be held to the same discipline as is present in industrial plants. Such schools should be free, thus placing the student under obligation to the school for his education rather than the school under obligation to him for his tuition. After graduation the student will be obliged to hold his position through his own efforts and ability. In such an institution the student should hold his place by the same qualifications. The student will graduate with a comprehension of the value of time and he will have been subject to a discipline which will be of inestimable value.

We began by estimating the value of our colleges by their output, the graduate. We found him superior to the non-graduate, but defective in many ways. We have briefly discussed the reason for these defects and found them to be, first, a lack of forethought on the part of the student, together with inadequate assistance on the part of the college in selecting the course of study; second, a lack of appreciation of the relative value of different subjects in the development of the student; and third, a lack of suitable discipline and environment to prepare the student for assuming practical work in the most advantageous manner.

I have pointed out the remedies which appear to me to be most efficient. Some of these suggestions may appear extreme. The writer believes that it will take radical changes rather than a gradual development to accomplish the desired results.

Bearing in mind these remarks on general education, let us consider the specific subject of foundry education.

Foundry Education.

Foundrymen have for years urged that technical schools give more attention to foundry subjects. These requests, however, have been so indefinite that the schools have been at a loss to know just what was required. Discussions which have arisen in associations and trade papers have been characterized by a con-

fusion of ideas as to what could constitute a suitable school or course in foundry practice. This has been due to the fact that two distinct problems have been confounded. A clear understanding of this fact would make future work along this line more productive. You are interested in foundry education in two definite ways: First, in the education of students who will advance into managers and engineers, and, second, in the education of your molders and apprentices. It is an absurdity to suppose that one and the same course of education will answer for both conditions. The methods adopted to train a student to enter the foundry with an idea of eventually becoming an engineer or manager would not be the most effective for making a molder or an apprentice more proficient at this trade, or fitting him for a foreman or superintendent. The material to be developed and the results aimed at are not the same and an entirely different method of instruction will be necessary. This is caused by a situation which it will be impossible to change. The two conditions are not to be created, but are already in existence. The apprentice and the molder in the majority of instances have only a common school education. When a boy completes a high school training, he seldom spends the time necessary to learn a trade. If the molder is to be educated, a course of study must be organized which will take these facts into consideration.

I dwell upon this point in order to emphasize that the two problems do exist, one of which concerns the preparation of young men to solve the questions of foundry science and foundry progress; the other relates to the developing of the molder into a better mechanic and a broader man.

I have confined my paper to a discussion of the first of these questions. We look to our technical schools for a solution, but find that they do not give the matter the attention which its importance warrants. There is a tendency to place this negligence at the doors of the schools and colleges. The fault lies to some extent with the foundrymen themselves. A concerted demand for courses in foundry practice backed by applications from students would help to bring forth the desired results. Schools are not given to creating demands, but rather to fulfilling them. The majority of such institutions are not overburdened with surplus funds so that they are not warranted in erecting buildings and hiring instructors unless there is some indication that there will be a use for them. There is no question in my mind that if a technical school should open a properly equipped foundry course with competent instruction, there would be a response which would more than justify the outlay. This however, is not after the manner of educational institutions. If we are to look to existing technical institutions for courses in foundry practice, we must convince them of the need of such instruction, not merely with words, but with applications of students and demands for graduates. It was the great demand for educated electrical engineers which, a few years ago, forced all technical schools to install electrical courses. It will be the demand for foundry engineers that will necessitate such institutions adding foundry training. It lies with our associations to make these demands and to back them with a support that will insure success.

Several technical institutions have already installed small foundries which give the students opportunity to become familiar with the ordinary routine followed in making light castings. The foundry is in charge of a practical molder, who explains to the class as much about the mechanical side of molding as is possible in the few hours per week that are given to this branch of work. There is but one advantage to the student, viz., he becomes familiar with the materials used in that special school. An equal amount of information could be acquired in any foundry in a week's time. Such courses do not teach advanced foundry practice; in fact, they only illustrate it in its most antiquated form. Instead of being instructed in the most modern methods of making castings, the student is trained to do by hand what is now done with machines with a great

saving of labor. The same fault exists in the teaching of cupola practice. The amount of coke and the proportion of expensive pig iron used would bankrupt a foundry working on a commercial basis. Careful attention is given to perfecting students in the use of hand ladles for pouring castings, instead of teaching them the modern methods of handling iron by means of cranes, trolleys, etc. The present procedure gives the student no idea of economy in time or materials. It makes him impracticable and, to a certain extent, impossible until he has spent a year in getting rid of his antiquated ideas, and another year in catching up to the times.

A foundry course to be of value should specialize in foundry practice; it should not merely teach molding from a mechanical standpoint. The reasons for making different castings in special ways should be explained; the occasion for the several methods of gating should be made clear and demonstrations of properly and improperly gated castings shown. Feeding ought to be illustrated by examples showing the effect of different sizes and positions of risers. Castings correctly and incorrectly vented should be made to prove the importance of proper venting. The student ought to be given examples of the most modern methods of making different grades of castings. Machine molding, green sand, dry sand, and loom work should be illustrated and the advantages of each explained. It is more important that the student understand the principles which underlie the practical operation than that he be able to do the work with his hands. The mere ability to ram sand is of no value to the student, the value to him lies in being able to judge by the appearance of the castings whether the sand has been rammed too hard or not hard enough.

A school that turned out finished molders would be a valuable institution. It is not for this purpose, however, that we send students to technical schools. It is to have them taught those things which the practical molder with more limited view cannot see. Mere ramming of sand under an instructor who has, nine cases out of ten, never even had experience as a foreman, does not teach them this. They must be taught to think and reason correctly as to cause and effect and then they will prove of value in our foundries.

The student should also study different kinds and grades of foundry materials, such as sands, blacking, binder, etc., analyze them, note their composition, and the effects of their use.

They should be taught to analyze the iron, to make up the mixture and to analyze the resultant castings. Different grades of castings should be made and thus give the opportunity to study the characteristic effect of various compositions on the physical structure.

Cupola changes should be studied and advanced cupola construction taught. The improved condition existing in the most modern foundries should be brought to the attention of the student by example when possible, and when not by lectures and illustrations.

In addition to these subjects, which pertain directly to the foundry, instruction should be given in metallurgy, electricity, mechanics, steam engineering, mathematics, drawing, etc., bearing in mind that time should be devoted to these subjects only in proportion to their relative value to foundrymen. For example, attention need only be given to that part of electrical and mechanical engineering which will prove of practical value to the foundry engineer in supervising the installation and operation of electrical and mechanical appliances in connection with the foundry. This point cannot be too strongly emphasized. I appreciate the value of studying the basic principles of any branch of learning. In a special course the theory and basic principles of the subjects which are most important to that course should be given the preference and only such time devoted to other allied subjects as their relative value or importance warrants.

Together with the above course of study, the student should be surrounded by the discipline discussed in the first part of the paper in order to train him for the duties and responsibilities which

he will be obliged to assume in actual work.

A foundry course conducted upon the above lines, aided by the advice of practical foundrymen, employing for instructors only those who have had successful careers in up-to-date foundries would turn out a class of young men as graduates who would be capable of at once assuming useful positions in our foundries, and who should in a few years develop into successful managers and engineers.

It is Ruskin who says, "Truth is never learned in any department of industry by arguing, but by working and observing." So I would urge upon you as individuals and as an association to take up this matter of education and to work and to observe. We have had the matter before us in one form or another for several years and yet have accomplished but little definite work. It may be we have had too much arguing and too little "working" and "observing."

Improved Method of Turning Valve Cores.

By James R. Kelly.

In making valves and steam cocks most foundries use the well-known method of supporting the cores by means of

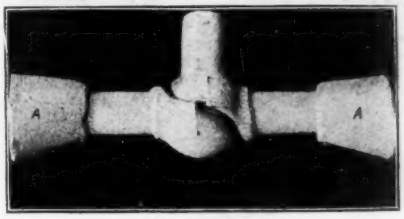


Fig. 1.—Valve Core Made in Halves.

a large core print on the pattern, which, while necessary to support each half of the core in the mold, occupies a considerable amount of space in the molding box or flask, which might otherwise be available for actual castings. The writer recently had the opportunity of seeing a neat method of utilizing the space taken up by the enlarged cores for additional patterns in the same flask which is successfully used at a well-known brass works in the north of England. This arrangement enables ten or twelve valves to be moulded in the same size of flask previously filled by four to six. By the courtesy of M. H. Creighton, A. M. I., M. E., the patentee of the arrangement, the following description is available: Under the old method the valve core was made in two halves as shown in Fig. 1, the taper ends of the core at A A being intended to support the main body of the

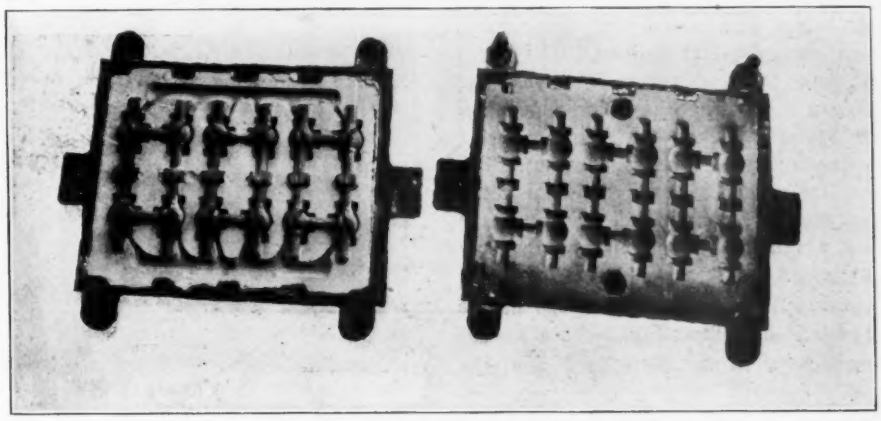


Fig. 2.—Cores in Place, Mold Ready for Casting.

core without the aid of studs, which are, of course, impossible for a good valve

casting for the present day high steam pressure.

As will be seen, when four or six valves are fixed on one plate pattern, these ends occupy a good deal of the entire mold, which is absolutely non-productive. Mr. Creighton arranges the pattern on the plate so that every square inch of its surface is brought into use for actual castings. Fig. 2 shows the two halves of a mould ready for casting, with cores fixed in position. The molding box contains 12½-inch valves, and when it is seen that the inside dimensions are 15 x 12 inches, the saving effected by the improved style is apparent. The size and weight of the flask is not above the capacity of an ordinary one, the total weight ready for pouring being only 110 pounds, and each half is about 55 pounds. An ordinary molder can handle it without difficulty. Fig. 3 shows an enlarged view of the cores in Fig. 2, the square portions of the core being arranged to give the correct position.

In a later arrangement these square parts are replaced by a right angle extension of the main core, and of the same diameter. This is plainly shown on the photograph, Fig. 4, of a pattern plate, on which eight 1-inch valves are fixed. As every foundryman will understand, this will leave the sand more readily than the square core print, and answers the same purpose.

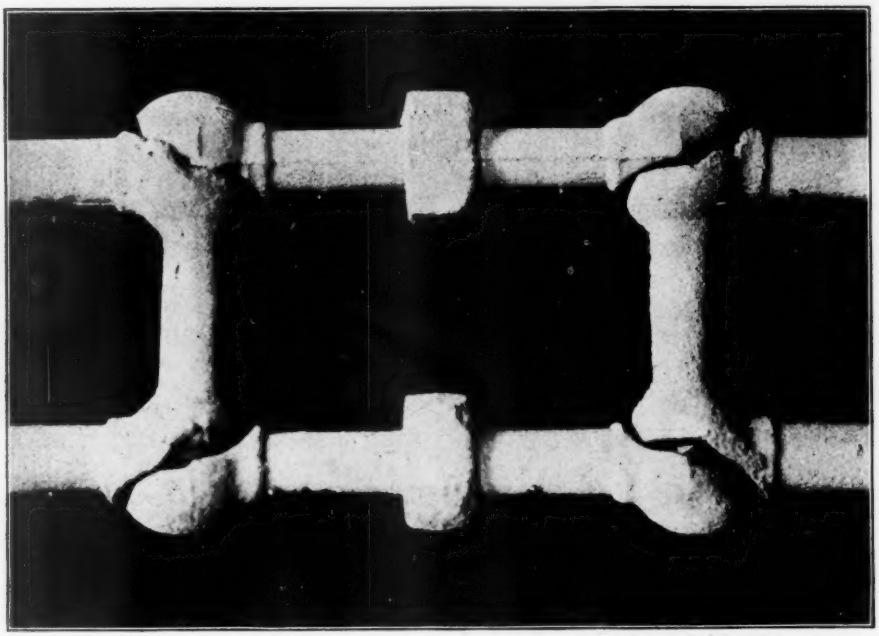


FIG. 3.—ENLARGED VIEW OF CORES.

The method of making the core boxes is interesting, and from the drawings, Figs. 5 and 6, it will be seen that there is no possible chance of the core being made except to the actual size desired. As a number of girls are employed making cores in this foundry, some positive

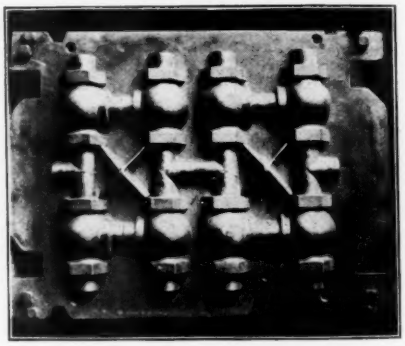
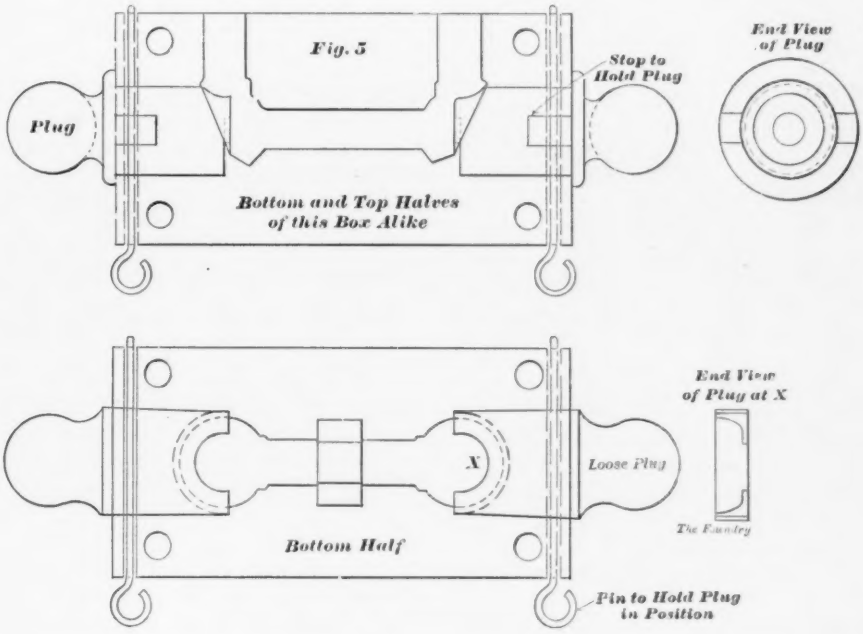
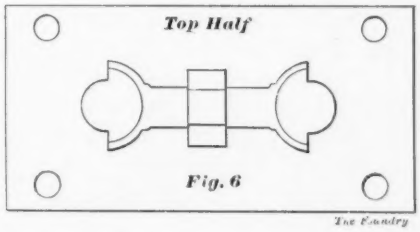


FIG. 4.—PATTERN PLATE ON WHICH EIGHT VALVES ARE MOUNTED.

method of preventing mistakes is necessary, both in making the cores and placing them in position in the mold Great credit is due to the designer, as neither in the core room nor the foundry can



mistakes be possible. This is a point which will appeal to all makers of brass valves, as the smallest inaccuracy in placing a core in position means a difference in the thickness and weight of the resulting castings. In fact, the castings now being made from the plate pat-



terns and core boxes described are practically perfect, both as to weight—an important point where large quantities are made—and in the thickness of metal at the valve seat. A valve which was cut through the center showed a section like a drawing and spoke volumes for the makers, considering that unskilled labor was used for the greater part of the work.

The pattern plates and molds shown in the accompanying illustrations are used and made on the Herman jarring molding machine, manufactured by the Herman Pneumatic Machine Co. Zelienople, Pa.

THEORY AND PRACTICE.

Wilson E. Symons, president of the Pioneer Cast Steel Truck Co., Chicago, addressed the Engineering Assembly of the Purdue University, Lafayette, Ind., on Jan. 21. Mr. Symons chose for his subject, "Theory versus Practice in the Work of the Mechanical Engineer," and drawing upon an extensive personal experience, he presented his subject in a manner which was most interesting and instructive to his student audience. He described the helplessness of a man trained in theoretical matters only, discussed with care and discrimination the limitations which surround one whose entire stock in trade is his practical experience, and drew a fine picture of the opportunities which await the one who combines the theoretical with the practical.

A PECULIAR CHILLED CASTING.

By George C Davis.

The casting, to which I am about to call your attention, presents some unusual features. For this reason I wish to describe it even though I have no theory as to its cause, nor am I able to give all the data.

As shown in Fig. 1, it varies in thickness from ⅛ to ½ inch and in

Fig. 1.—Casting Showing a Peculiar Chill.

places has a wedge shaped chill surrounded by gray iron on each side. A part of the casting even in the light section, is gray without trace of chill, though it is hard. The analyses are given in Table I.

Table I.

	A.	B.
Silicon	2.61	3.16
Sulphur	.106	.102
Phosphorus	.60	.74
Manganese	.36	.19
Graphite		.25
C. Carbon	3.40	3.04

Owing to difficulty in sampling I am not able to present a separate analyses of the gray and white portions. The figures given under A represent the casting illustrated in Fig. 1. The drillings were taken as near as possible to the chilled part. Sample B was taken at the foundry and represents the white portion from several castings made at a later date than A.

Before proceeding with the discussion I will give the method of charging so far as I can.

Diameter of cupola	48	inches
Bed of cupola	400	lbs. broken coal
Bed of cupola	1,400	" coke
Smelting charge	4,000	" pig
Smelting charge	2,000	" sprue
Subsequent charges	350	" coke
Subsequent charges	1,600	" pig
Subsequent charges	1,200	" sprue
Total melt about	15	tons

*Read at December meeting of the Philadelphia Foundrymen's association.

The first discussion I have been able to find on internally chilled castings, is in Vol. 17, p. 700 of the Transactions A. I. M. E. An analysis is given which is shown in Table II.

Table II.

	White inside.	Gray outside.
Silicon	2.74	2.85
C. Carbon	2.55	1.75
Graphite	1.31	1.87
Manganese	.50	....

Phosphorus and sulphur are not given, but it is stated that no marked difference in these elements was found in the two samples. Internal chill is sometimes seen in pig iron and this was at first thought to be due to segration of sulphur or manganese. So far as I know, this has never been proven and the analyses I can recall show little difference between the gray and the white portions of the pig except in the ratio of graphite to combined carbon.

To return to the casting under discussion, the silicon in A is correct for light work and should give good results; sample B is too high in this element and I should expect a weak iron but not a chill.

The sulphur in both cases is not excessive. In connection with this I would call your attention to the fact that while sulphur usually causes hard iron, it does not always do so. I give in Table III two analyses of bad castings high in sulphur. These were "water backs" for ranges. They leaked under the hydraulic test and when broken showed a porous fracture with reddish spongy spots as indicated in the analyses both were soft iron, yet they contain more sulphur and less silicon than A. Another "water back" casting first class in every respect showed .096 per cent sulphur or nearly as much as sample A. I do not think there is any reason to attribute the chill to sulphur.

Table III.

Defective Castings.

	A.	B.
Silicon	2.49	2.53
Sulphur	.153	.142
Phosphorus	.68	.73
Manganese	.52	.46
Graphite	2.94	2.63
C. Carbon	.24	.59

The phosphorus in both A and B, is about as it should be, there is no reason to suppose it had anything to do with the chill.

The manganese evidently had nothing to do with the chill as it is normal in A and low in B. The total carbon in A is correct for this class of work. In B it is a little low as might be expected owing to the high silicon, for in pig iron, as a rule, silicon increases, carbon decreases. It is believed by many that pig iron made from magnetic ore has peculiar chilling properties. In this case samples A and B were made from three brands of pig iron and sprue from previous heats. One brand is a southern iron, and the other two local irons. Of the latter, one was made from an ore mixture containing about nine per cent magnetite and the other 35 per cent of "local ores" which were probably mostly magnetite. The mixed pig irons would only represent a small proportion made from magnetite and I think we can safely dismiss this theory in this case.

Another theory held by many, is that the cause is in the management of the cupola and pouring. I quote the views of a well-known furnaceman who writes me as follows:

"I have noticed that this peculiar condition,—gray on the exterior, and white on the interior, oftentimes in very thin pieces of casting, is due more to the melting of the iron than to the chemical composition of the iron. It cannot occur, however, with low-silicon iron. So far as my experience goes it is characteristic of the use of high-silicon iron which has been melted in a cupola with a cold bottom, enabling the iron to take up sulphur, or the iron has been melted, and run into cold ladles, under which condition, certain chemical changes take place, which have been remedied by melting the iron hotter, thus reducing the percentage of sulphur, and also in tapping the iron into hot ladles instead of moderately warm ladles.

Apparently the analyses given in the first part of the paper gives us no clew as to the cause. The theory which I have just quoted is a question for foundrymen rather than chemists, so I leave the subject with those present for discussion.

PECULIAR PROPERTIES OF ALLOYS.

The alloys of lead, tin, and bismuth show peculiar properties. A mixture consisting of bismuth two parts, tin one part, lead one part, melts at a temperature slightly below the boiling point of water. It also expands on cooling.—*The Mechanical World.*

VALUE OF TECHNICAL PAPERS.*

By G. W. Keller.

The advancing foreman of today must be up to new ideas and keep moving; he has no time to sit with his hands folded. The proper use of mechanical literature is the foundation of success. The good, energetic mechanic waits hourly for his mechanical journal to arrive; how would our minds be enlightened if it were not for this? We would never have anything before us that would give us any reason to improve or make improvement. Every month there is something new that is very beneficial to the mechanic, and, I am sorry to say, that not one-half the mechanics that would be benefitted read these papers. The country has produced some of the finest graduates in the mechanical line, and it is these who are worrying their minds about modern mechanics and improvements that when published are beneficial to you and me. I think if every foreman would stop long enough to think where he is in this hustling, modern, improved mechanical world, he would subscribe for more mechanical literature.

*Read before the convention of the International Railway General Foremen's Association.

THE CHARACTERISTICS OF FOUNDRY IRON.*

Including a Resume of its Micro-Constituents.—Results of Mixtures of Different Grades.—Reactions in the Ladle.—Causes of Defective Castings.

By George Hailstone.

The irons used in foundries are generally very complex in character, and the recognition of the value of a knowledge of their characteristics is gradually spreading. We find that in the selection of pig iron for foundry use, antiquated methods are in some foundries still being employed, the quality still being judged by the appearance of the fractured surface.

The darker the color, the larger the flakes of graphite, as well as the grain, the better the quality, according to these old time views, which are based upon the influence of silicon on the formation of graphite. Silicon being the most important constituent of foundry irons, these views were to some extent true, but on the other hand, when silicon contents of an iron are increased. the capacity of that iron for dissolving carbon diminish, the result being that in the high silicon irons there is but relatively little carbon and the grain of the metal is consequently small instead of large when the fractured surface is examined.

It costs more to produce such a high silicon iron in the blast furnace, yet the blast furnace manager sees his more expensive iron valued by the antiquated foundryman at a lower rate, simply because the fracture does not look well in his estimation. At present, with large furnaces and hot blast, there is often no connection between the silicon contents and the fracture of an iron.

Fig. 1.

Fig. 2.

The fracture of iron also depends very largely upon the rate of cooling of that iron. Speaking in a very broad sense, if the iron is cooled slowly we get a gray iron, if cooled quickly a white iron, and if cooled moderately slow a mottled iron. The blast furnace man could cool his iron to suit his customer, if the customer buys by fracture. If the iron is bought upon a chemical analysis, it is impossible for the blast furnace man to deceive the foundryman.

In the more up-to-date foundries we

*Read before the Birmingham Branch of the British Foundrymen's Association, January 19, 1907.

find that the iron bought is subjected to a chemical analysis, and sometimes run through the cupola and test bars cast from it, which are tested, so that the foundry manager has a complete record

FIG. 3.

of each brand of iron, also the microstructure is examined before and after going through the cupola. Every delivery of iron has to be tested, as we find it a very rare occurrence, except in a few cases, that the deliveries of the same brand of iron extending over a period

FIG. 4.

of a month or so agree in chemical composition.

For the sake of simplicity I have divided this paper into the seven following sections:

Section 1.—The micro-constituents of foundry irons.

Section 2.—The effects of the metalloids on foundry irons.

Section 3.—The irons used in the foundry.

Section 4.—The mixing of foundry irons.

Section 5.—The reactions of additions in the ladle.

Section 6.—The causes of defects in iron castings.

Section 7.—The composition of iron for different castings.

As there is enough in each of these sections to form a paper I shall be only able to go into them very briefly.

The Micro-Constituents of Foundry Irons.

Section 1.—The first constituent is fer-

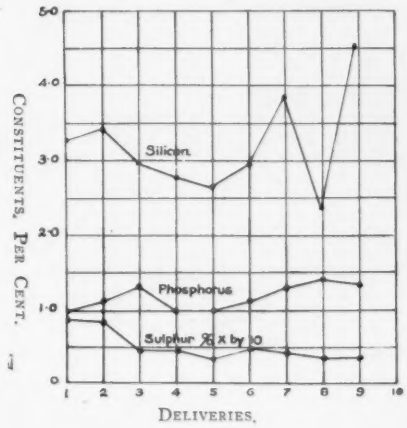


FIG. 5.

rite. This is pure iron which sometimes occurs in crystals that are readily recognized, but more often than not as a white ground work or matrix. Being unstained by the etching liquid that is used to reveal the various constituents, it remains white. Silicon and manganese are present in the ferrite, and as they are isomorphous with the iron, they often replace some of the crystals of ferrite. Ferrite is the softest constituent of cast iron excepting graphite. Fig. 1 shows crystals of ferrite, through which runs a very large flake of graphite. The second is a constituent called cementite, which is a chemical compound of carbon and iron corresponding to the formula Fe_3C. The iron is sometimes replaced

in this constituent by the other metals associated with the iron. For instance, we get double carbides if iron and manganese. Cementite is the hardest constituent of cast irons; it resembles ferrite inasmuch as it is not stained by the etching liquid, but being very hard it stands up in relief after polishing and is therefore readily distinguished. Fig. 2 shows a micro-section in which the cementite is the white portion, the black portions in the cementite being phosphorus eutectic.

The third constituent is pearlite, which is a mixture of ferrite and cementite. It

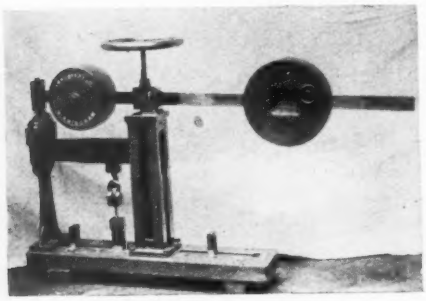


FIG. 6.—TESTING MACHINE.

is recognized by its characteristic structure, consisting of alternate lamine of ferrite and cementite. It is colored dark by the etching liquid, and when the specimen is a good one, it has a very beautiful mother of pearl appearance. Probably you will wonder how it is that pearlite is colored by the etching liquid, as ferrite and cementite when in segregated patches are not colored. The explanation may be that as the cementite is the harder constituent, and in polishing the ferrite is rubbed away much more easily and therefore the cementite stands up in relief. When the etching liquid is put upon the specimen some of it falls into the recesses formed by the rubbing away of the ferrite and is not completely removed in the final polishing; also as cementite stands up above the ferrite, shadows are formed, and we therefore get this peculiar streaked appearance. Fig. 3 shows the structure of pearlite, the light portion being cementite and the dark portion ferrite.

The fourth constituent is graphite, which is practically pure carbon in the free state. It occurs in cast iron in varying sized flakes from very large to very small. Fig. 4 shows large and small flakes of graphite in a matrix of ferrite.

The fifth constituent is the phosphorus compound or eutectic. This constituent is very hard and is left standing in the cementite in the form of dots and lines. Fig. 2 shows the phosphorus compound in the cementite.

The Effect of the Metalloids on Foundry Irons.

Section 2.—Carbon exists in cast iron in two chief forms, as graphite, when it is mechanically mixed with the iron, and as combined carbon or cementite when it is in chemical combination with the iron. When cast iron is in the molten state it is considered as a solution of solid carbon in liquid iron. If the molten solution is cooled slowly through certain temperatures, the carbon separates from the iron as graphite, and the longer time it has to cool through these temperatures, the larger the flakes of graphite. When the solution of carbon in iron is cooled very rapidly, some of the carbon is in the combined form and some is fixed. As there is very little known as to the difference of combined carbon and a solid solution of carbon in iron, I cannot discuss this point. The various other metalloids present in foundry irons act in different ways, either tending for the formation of graphite or combined carbon. Graphite opens the grain, weakens iron, reduces shrinkage and chill, and indirectly softens iron by being only mechanically mixed with it. Combined carbon closes the grain, increases shrinkage and chill and raises the strength.

Silicon may exist in iron as a silicide of iron, but this silicide appears to be in solid solution in the iron, forming crystals of the cubic system. Upon examining a micro-section of slowly cooled iron containing 3 per cent silicon, I have seen what I believe to be crystals of this solid solution to which we may give the name of "silico-ferrite," side by side with crystals of ferrite. The crystals of silico-ferrite are of a pale yellow color, and the ordinary ferrite white. I may say the colors are not a light effect, because on rotating the specimen

under the microscope the colors remain unchanged.

Silicon may be said to act in three ways in cast iron: 1.—By inducing the separation of graphite in large flakes. 2.—By inducing the separation of graphite in very minute flakes. 3.—By uniting with iron and manganese to form silicides, which tend to produce a large crystalline structure and increase the hardness and brittleness in proportion to the amount of silicon present. It does not appear to be able to unite with carbon at the ordinary furnace temperatures. To sum up, the effect of silicon on cast iron is to increase the hardness, but as it induces the separation of graphite, it acts indirectly as a softener. It also lessens shrinkage. By combining with any oxygen present it prevents blowholes. It increases the tenacity, but decreases the ductility.

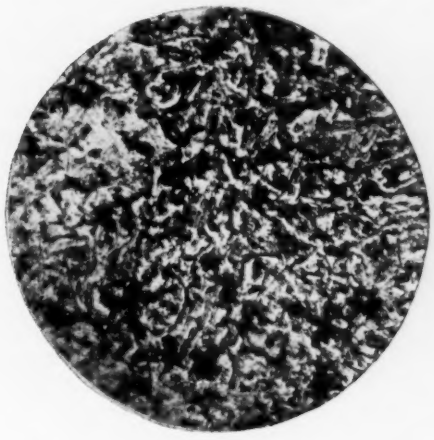


FIG. 7.—SECTION CAREW HEMATITE.
ANALYSIS:—G, 3.125; CC, 0.338; Si, 1.076; S, 0.057; P, trace; Mn, 0.874.

FIG. 8.—CLAY CROSS, NO. 4.
ANALYSIS:—Si, 1.332; S, 0.069; P, 1.501.

Manganese.

The condition of carbon in cast iron being influenced by manganese is most likely partly due to its having the power to combine with carbon on its own account, thereby increasing the quantity of combined carbon in the iron. It also has an affinity for silicon and sulphur, which form manganese silicide and manganese sulphide respectively. When the manganese is present in the quantities generally present in cast iron manganese prevents the oxidation of iron when in the molten state, being itself more readily oxydized and passes into the slag as manganese silicate. The slag forming tendency of the manganese tends to produce basic slags, which are most favorable for the elimination of sulphur, as the more basic the slag the more completely will the sulphur be removed.

Manganese increases the shrinkage of cast iron and Keep has shown that an increase of 1.0 per cent of manganese increases the shrinkage 26 per cent. In all probability this is due to the manganese retaining the carbon in the combined form. Manganese increases the hardness of iron enormously, thus being advantageous in producing a hard chill. The general effect of manganese on cast iron is to cause the carbon to remain in the combined form, and therefore increase the hardness and shrinkage to prevent blowholes by combination with oxygen; to produce a hard chill, to unite with sulphur and in this respect decrease the hardness; to form a basic slag and thus partly remove the sulphur and phosphorus; to produce a close grain, and, therefore a strong casting, and to increase the transverse strength.

Sulphur.

In ordinary gray iron castings we seldom get the sulphur above 0.13 per cent, but when present, even in very small quantities, it exerts a considerable influence on cast iron. Sulphur generally exists in the iron as a sulphide, and

when manganese is present as manganese sulphide, iron sulphide being readily fusible, and also decomposes at high temperatures, a large proportion of the sulphur escapes as a gaseous compound,

FIG. 9.—BESTWOOD SILICIOUS PIG IRON.
ANALYSIS:—G, 3.860; CC, ————; Si, 4.359; S, 0.030; P, 1.122; Mn, 0.372.

giving the metal a spongy texture. When manganese is present, the sulphur appears to unite with it in preference to iron, and as manganese sulphide has a high melting point, and also a high dissociation point, the sulphur is not then liberated in the gaseous form, so that blowholes and red shortness are to a certain extent avoided. In examining samples of cast iron under the microscope I have found that when the sulphur is below 0.11 per cent the manganese sulphide is always found in the cementite, but when the sulphur is above 0.11 per cent, I find some manganese sulphide in the pearlite.

The tendency of sulphur is to neutralize silicon. It acts in a similar way to manganese in keeping the carbon in the combined form. Sulphur generally increases in iron as silicon diminishes. As sulphur exists as a moderately fusible sulphide in cast iron, it is liable to be retained in the liquid form after the mass of the metal has become solid, and tends to segregate in the middle and upper parts of the casting. Sulphur makes iron more fusible and liquid by the formation of a fusible sulphide, as it tends to form combined carbon, the iron is harder, and the shrinkage is increased. With a high sulphur content, the absence of manganese, and a high casting temperature, blowholes result. Because of high shrinkage, castings are liable to fracture and because of combined carbon, high sulphur iron produces a deep chill, as segregation occurs and blowholes and fusible sulphides are formed, all of which produce intercrystalline weakness. Sulphur also tends to diminish the strength of cast iron.

Phosphorus.

Phosphorus exists in cast iron as a fusible phosphide, having the composition, Fe_3P., which contains 15 per cent phosphorus. Practically the whole of the phosphorus in an ore charged into the blast furnace passes into the pig iron produced.

Phosphorus has little direct influence on the condition of the carbon. Iron phosphide is very hard, but not as hard as cementite. It is found associated with the cementite. On examining a micro-section of an iron containing phosphorus we find that the phosphorus compound is in the cementite in the forms of streaks and dots.

Phosphorus increases the fluidity of cast iron considerably, hence the use of highly phosphoric iron for fine castings,

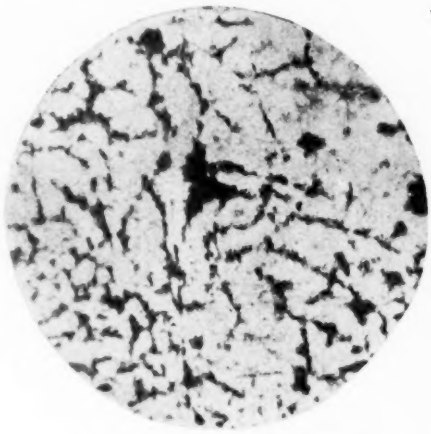


FIG. 10.—BURNT CAST IRON.

where the strength is only a secondary consideration. As the phosphide remains fluid after the main bulk of the iron has solidified, an excess seems to have a mechanical influence on the cementite by

causing it to run in nearly straight lines throughout the casting, thus forming lines of weakness and therefore making the iron more brittle and more easily fractured under impact. The presence of phosphorus lowers the percentage of total carbon, and this increases proportionately with the increase of phosphorus. With 2 per cent of phosphorus in pure cast iron there is probably not more than 2 per cent of carbon. For strong castings phosphorus should not exceed 0.6 per cent, and when the amount exceeds 1.5 per cent the iron becomes very weak and also hard.

Summarized briefly, the effect of phosphorus on cast iron is to make the metal harder, more fusible, white, more fluid and weak. It prevents blowholes and lessens shrinkage.

The Irons Used in the Foundry.

Section 3.—The pig irons used in the foundry differ very much in composition and generally speaking each iron making district produces a class of iron peculiar to itself. Thus we have Scotch, Cleveland, Froddingham, Derbyshire, Northamptonshire and north and south Staffordshire pig iron. Also hematites, cold blast, basic and cinder pig iron. The table of analyses, No. 1, shows the typical chemical composition of irons used in this district. These are only very approximate compositions; in fact, every delivery of pig iron varies a little. The curve, Fig. 5, shows the partial analysis of a South Staffordshire No. 3 iron of the same brand, the deliveries of which extend over a period of three months. The silicon varies from 2.3 to 4.66 per cent; the phosphorus from 1.0 to 1.4 per cent, and the sulphur from 0.035 to 0.085 per cent. It can be readily seen that to use this iron, or any iron satisfactorily, analysis should be taken of every delivery, each delivery being piled in a separate stack and labeled, when it may be mixed and used without fear.

Sampling Iron.

The methods of sampling pig iron are great in number, nearly every works using a different method. I think one of the best methods is to take half a pig from every five tons of iron and drill the pig from top to bottom, through the center. I think a very true sample is then obtained. I once had an occasion to estimate the sulphur in the top portion of a pig, and also in the bottom portion of the same pig. I found 0.037 per cent of sulphur in the top portion, and 0.11 per cent sulphur in the bottom. I then drilled the piece of pig iron through the center from top to bottom, and I found that the sulphur came out at 0.074 per cent, which is almost the mean of the two first sulphur estimations. The sketches show the method of drilling.

I think this experiment proves the method of sampling.

Table I.

Brand of Iron.	G	C C	Chemical Analysis. Si	S	P	Mn
I X L No. 5, (cold blast)	3.270		1.85	0.08	0.39	0.75
Barrow Hematite, No. 3	3.44	0.16	1.85	0.04	0.05	0.79
Denby, No. 3	2.98	trace	2.67	0.06	1.45	0.35
Hatherton, No. 3	3.26	0.21	3.15	0.05	1.12	0.76
Brightside, (refined iron)	2.14	0.85	1.44	0.06	0.14	0.36
Madeley Wood, (cold blast)	2.28	0.72	1.26	0.05	0.76	1.29
Harrington Hematite	2.44	1.04	1.82	0.06	0.04	0.14
Stanton, No. 3	3.31	0.20	2.80	0.04	1.20	0.72

METHODS OF DRILLING FOR SAMPLING PIGS.

Grading and Mixing by Fracture.

The following three analyses, I think, will show the error of grading and mixing by fracture. The examples are of No. 3 irons of different brands:

	No. 1.	No. 2.	No. 3.
Graphite	3.20	3.30	3.26
Combined Carbon	0.33	trace	0.21
Silicon	2.59	3.94	3.15
Sulphur	0.04	0.04	0.05
Phosphorus	1.14	0.84	1.12
Manganese	0.59	0.66	0.76

It can readily be seen what trouble the foundryman will have if he happens to use No. 1 iron in place of No. 2 for a certain casting, as the difference in silicon is nearly 1.5 per cent.

I mentioned, in the first part of the paper, that a great deal of information

FIG. 11.—SECTION FROM FAIRLY LIGHT CASTING.

ANALYSIS:—G, 3.103; CC, 0.216; Si, 2.693; S, 0.068; P, 1.020; Mn, 0.610.

may be obtained if samples of different brands of pig iron, used in the foundry, are melted in the cupola with a standard blast pressure, etc., and test bars cast from this metal and these test bars then tested in their various ways. From the results obtained, and the chemical composition and microstructure, the irons may be used for their different purposes with certainty.

Fig. 6 is an illustration of a very useful combined testing machine for use in a foundry. This machine is made by Messrs. W. and G. Avery, Ltd., Soho Foundry, Birmingham. The transverse capacity is 40,000 pounds, and the tensile capacity 60,000 pounds. For tensile tests the bar used is 0.5 inch in diameter, which makes the capacity of the machine 15 tons per square inch. Hardened steel dies for gripping the test pieces 0.5 inch diameter are provided. For transverse tests the machine will take bars 2 inches x 1 inch section or less, and up to 36 inches between the centers. The bed plate is of cast iron, fitted with dogs for holding the transverse test pieces, adjustable to suit different lengths of bars, the base being graduated, so that the bars may be accurately located at either 12 inches, 24 inches or 36 inches between the centers. A graduated deflection scale is attached to the machine by means of which the deflection may be taken at any period during the test. The scale is graduated in 1-20 inch divisions on one side and 1-16 inch divisions on the other.

A cast iron standard is bolted to the base plate, fitted with hardened steel bearing blocks, upon which the fulcrum knife edges of the steel yard rest. The steel yard is fitted with a sliding poise by means of which the steel yard is kept in equilibrium and the load indicated. The strain is applied by means of a hand wheel, screw and stirrup, which exerts the strain onto the specimen. To minimize the shock on the steel yard due to the breaking of the test piece, a spring buffer is fitted to the steel yard carrier.

The next micro-photograph, Fig. 7, is of Seaton Carew hematite. Fig. 8 is a micro-photograph of a low grade iron known as Clay Cross No. 4. Fig. 9 is a micro-photograph of Bestwood silicon pig iron.

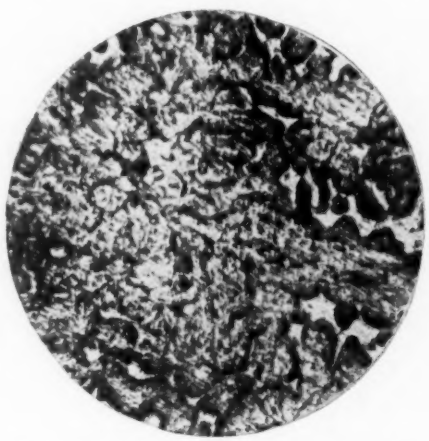


FIG. 12.—SECTION FROM SMALL MOTOR CYLINDER.

Transverse strength on 2 x 1 inch bar having three foot centers was 3,400 pounds, with a deflection of ⅝ inch.

ANALYSIS:—G, 2.410; CC, 0.586; Si, 2.316; S, 0.123; P, 0.900; Mn, 0.356.

Scrap.

The last iron I shall deal with used in the foundry is scrap. The tendency of graphite to form when cast iron is cool-

ing makes thin castings soft, otherwise they may be too hard to machine. The remelting of cast or pig iron tends to reduce graphitic carbon, by the increase and decrease of the other metalloids, and therefore scrap, being remelted iron, is profitably employed where the castings are thick and heavy, in order to close up the grain of the iron and make it solid and strong, even where it is thick in section. It is seen that scrap should be used more carefully and sparingly in thin castings, and used freely and in considerable quantity in large and heavy work, the only danger being that every time the iron is melted it is liable to increase in sulphur content. It is not safe to use much scrap of unknown character, as the sulphur may run too high.

Scrap iron should be used rather to improve the quality of the iron than to cheapen the cost. If the improvement in quality is kept in view, it will lead to rejecting any pieces which are unfit to use, such as burned iron found in annealing boxes, fire bars and similar sections. Fig. 10 is a micro-section of iron from an old annealing box. It can be seen that this is full of cracks containing iron oxide, and very unfit for remelting.

The scrap iron made in the foundry, such as is readily classified, being similar in composition to the castings produced. Purchased scrap doubtful in character, and may be classified as follows:

	Heavy Machinery Scrap.	Miscellaneous Light or Medium Scrap.
Silicon	1.80 per cent	2.00 per cent
Sulphur	0.11 per cent	0.11 per cent
Phosphorus ...	0.80 per cent	1.20 per cent

It is always advisable to take a good average sample from each delivery of scrap iron, analyze, and to work upon that analysis.

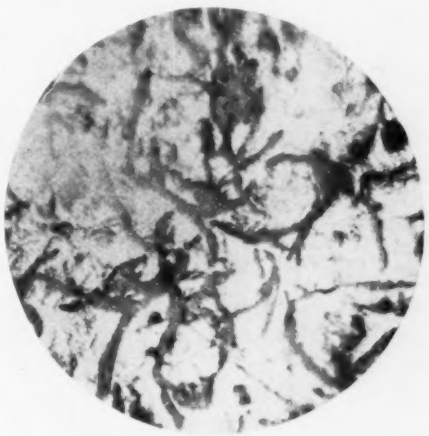


FIG. 13.—SECTION FROM CASTING OF MEDIUM SIZE, SHOWING THE GRAPHITE FLAKES.

ANALYSIS:—G, 2.500; CC, 0.589; Si, 2.167; S, 0.123; P, 1.150; Mn, 0.533.

The Mixing of Foundry Irons.

Section 4.—There is in practice a definite limit for the silicon contents of a gray iron casting. It should not contain less than 0.8 per cent, nor more than 3 per cent of silicon. If it exceeds 3 per cent, then in thin castings the metal is liable to be very hard and have a bright, glossy fracture. If there is less than 0.8 per cent silicon, even the thickest castings are too hard and are liable to be quite white and brittle.

The calculation of a charge of iron by the use of the analyses of the various irons to be used in the charge is very

Table II.

Irons used.	Pounds.	Si	Total Si	P	Total P	S	Total S
Priorfield No. 3	200	3.495	6.990	1.025	2.050	0.032	0.064
Special Hydrate	200	3.865	7.730	0.765	1.530	0.043	0.086
Diamond	100	2.310	2.310	0.895	0.895	0.038	0.038
Hematite	100	2.195	2.195	0.050	0.050	0.012	0.012
Scrap	400	2.000	8.000	1.200	4.800	0.110	0.440
Total	1,000		10)27.225		10)9.325		10)0.640
			2.7225*		0.9325*		0.064*
Deduct for loss.			0.2500			Add	0.038
			2.4725*				0.102*

	Si per cent	S per cent	P per cent
Calculated analysis of mixture	2.472	0.102	0.932
Analysis of drillings from mixture	2.495	0.099	0.997
Difference between calculated and actual analysis.....	0.023	0.003	0.065

*Per cent.

simple. In the sample mixture, Table II., only silicon, sulphur and phosphorus are taken into consideration.

From the various irons available those are picked whose constituents when added give approximately the required

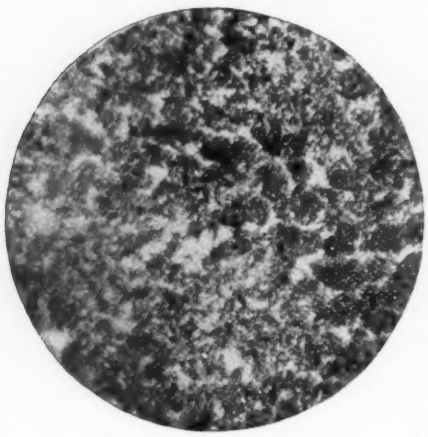


FIG. 14.—SECTION OF A VERY STRONG IRON,

Having a small and regular structure which is considered ideal. Transverse strength of a 2 x 1 inch bar, 3,700 pounds.
ANALYSIS:—G, 2.630; CC, 0.583; Si, 1.547; S, 0.117; P, 0.768; Mn, 0.497.

amounts of the different elements. Then the irons are mixed in various proportions until the proper charge is obtained.

It would be impossible to mix irons to the same degree of accuracy by fracture. There is also a great saving in expense, as any iron may be used, providing the chemical analyses are known, and as long as the combination yields the requisite percentage of each constituent.

The Reactions in the Ladle.

Section 5.—When iron is run from the cupola into the ladle, when the furnace is running properly, the iron is white hot. Sometimes it requires a number of tappings to fill the ladle. Care must be taken to prevent the iron from cooling. For this purpose ground coke may be thrown on. Allowing the iron to stand in the ladle has a good effect, providing it is not allowed to get too cold. The absorbed gases are given time to escape. The manganese and silicon act on any oxides present and decompose them, forming manganese silicate which passes into the slag. The manganese also has time to assist in the elimination of the sulphur present, by the formation of manganese sulphide.

This manganese sulphide rises to the surface of the metal and passes into the slag. The hotter the metal the more perfect these reactions. Sometimes additions of some foreign material are made to the metal in the ladle to eliminate dissolved gases and oxides, but with good irons this is not necessary. I do not think these additions are any great benefit to the metal, providing the right mixture is used for the right job.

The materials that are added to molten iron may be divided into two classes: (1) Those acting mechanically; (2) those acting chemically.

To the first type belong such alloys as lead, zinc and tin. These are added in the proportion of about 1 to 2 ounces per ton of metal. They boil away at the temperature of the metal and so agitate it as to cause the gases and impurities to rise to the surface. Stirring the metal before pouring has, however, the same effect. The metals mentioned above will not reduce oxides.

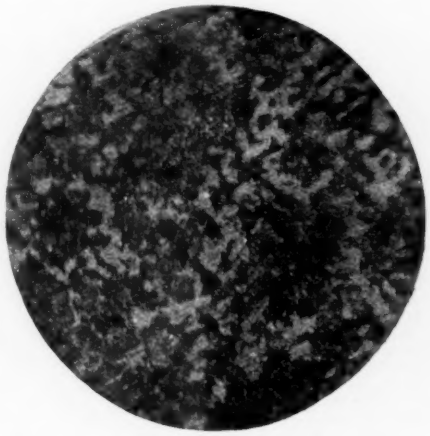


FIG. 15.—SECTION FROM A HIGH PHOSPHORUS IRON,

Fairly high in silicon. This metal is good for large castings, strength being a secondary consideration. The high phosphorus gives it a low casting temperature, and the high silicon promotes formation of graphite.
ANALYSIS:—G, 2.500; CC, 0.291; Si, 2.549; S, 0.062; P, 1.895; Mn, 0.642.

To the second group belong aluminum, sodium magnesium, and titanium. The use of sodium, magnesium and ti-

tanium is, at present, I think, very rare. They are undoubtedly present in the special alloys now sold, the addition of which to cast iron is supposed to strengthen, and in fact better it in all respects.

The addition of aluminum is more general. It is added either as pure aluminum, or as ferro-aluminum, in quantities ranging from 0.02 to 0.05 per cent of the weight of the iron to which it is added. The addition of aluminum is only effective when it is submerged below the surface of the iron by suitable means, otherwise a considerable portion is oxidized on top of the metal. Aluminum decomposes oxides even when the metal is relatively cool, the alumina formed passing into the slag. By the decomposition of the dissolved and mechanically mixed oxides the iron becomes more fluid and apparently hotter. It can be readily shown by calculation that the metal does not become any hotter, as the quantity of aluminum added is too small to exert any influence by its combustion on the large quantity of iron to which it is added.

The use of aluminum is limited to iron fairly high in silicon. With low silicon iron it cannot be used, because it easily promotes the formation of graphite. The addition of 0.2 per cent titanium to a low silicon iron, all the titanium being oxidized, is said to strengthen the iron 20 per cent. When the iron is about to be poured the surface is scraped clean and some dry molding sand thrown on the cleaned surface. This produces a thin coherent slag, which protects the metal from further oxidation during the casting process, while it is prevented from passing forward with the iron.

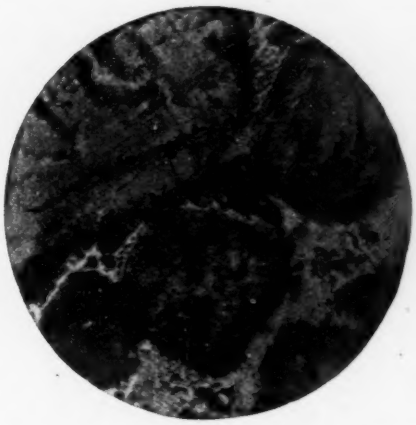


FIG. 16.—SECTION FROM A HEAVY WHEEL, Clearly showing the graphite, pearlite, cementite and phosphorus.
ANALYSIS:—G, 2.720; CC, 0.422; Si, 1.478; S, 0.071; P, 1.335; Mn, 0.591.

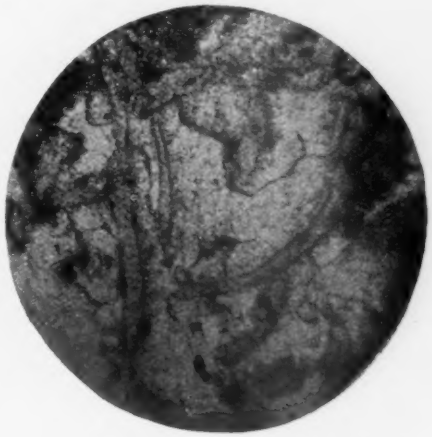


FIG. 17.—SECTION SHOWS RESULT Of use of iron too high in silicon for a heavy casting. The lines of weakness lie between the large flakes of graphite and the large crystals of ferrite.
ANALYSIS:—G, 3.520; CC, 0.129; Si, 2.269; S, 0.107; P, 0.873; Mn, 0.607.

The Causes of Defects in Iron Castings.

Section 6.—Blowholes are due to high sulphur, damp sand, defective cores, improper venting, and small and incorrectly placed risers and gates. Another common defect is due to the presence of dirt or impurities, especially owing to the washing away or breakage of part of the mould. Insufficient heat and shortage of metal is another cause of defects.

The feeding of some castings is of great importance to prevent blowholes and sponginess. Sponginess is due to the robbing of liquid metal from the heavy to a light part of the casting. Cracked and twisted castings are due to many causes, among which may be cited the unsuitability of the metal, and bad design of the pattern, allowing undue cooling strains. Insufficient weighting of the cope is a cause of other accidents and defects.

The Composition of Iron for Different Castings.

Section 7.—The kind of iron to be used for making a casting depends upon the size; that is, its thickness as affecting its rate of cooling. It is an impossibility to find any one mixture that is suitable for heavy and light work.

The iron that makes large castings close, solid and strong, would make a small casting hard and flinty and impossible to machine.

If only light work has to be cast, irons that are low in sulphur, fairly high in phosphorus, and high in silicon should be used. These elements will give softness, and at the same time sufficient strength for ordinary purposes. On the other hand, if large and heavy work is being made, where soundness and strength are required, the iron to be used must be harder, and is produced by using iron fairly low in silicon, lower in phosphorus, but there may be considerably more sulphur than could be allowed in light castings.

Table III.

Thickness of Metal in Body of Casting.	Constituents. Si	S	P	Mn
0.25 inch	2.7	0.05	1.0	0.4
0.50 "	2.40	0.06	1.1	0.4
0.75 "	2.40	0.07	1.2	0.5
1.00 "	2.00	0.08	1.0	0.6
1.50 "	1.75	0.10	0.8	0.7
2.0 "	1.50	0.11	0.75	0.7
2.5 to 3.0 "	1.25	0.12	0.60	0.8

Table III. is merely a suggestion as to the relation that should exist between the thickness of metal in the body of a casting and the chemical composition of the iron from which it should be poured. The micro-graphs, Figs. 11 to 17, are sections from various castings.

CAST IRON PIG BED.

By W. A. Jenkins.

Having provided for years some kind of a pig bed, or way to care for surplus iron after a heat, and for small amounts of iron too dull to pour, which at times cannot be returned to the mixing ladle, I immediately accepted a suggestion as good, in a hint dropped me by our foreman, Wm. Hassett, and designed and built a cast iron pig bed as shown in Fig. 1. In actual use it has proved more than satisfactory and has cost very little as compared to its merits. The sides are 16 feet long, 6 inches wide and 1 inch thick. This pattern was a board notched out to receive the trunnions on the pig mold with eight bolt holes ⅞ inches for the legs. Three of these pieces were cast, one going on the bottom back side, to keep sand, gaggers, clamps, etc., from the floor next to it out from the underside.

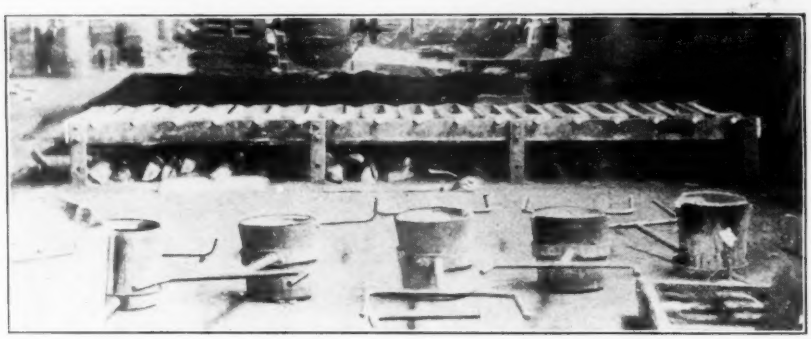


Fig. 1.—Cast Iron Pig Bed.

The eight legs are each 18 inches high,

1 inch by 4 inches, with a foot on the bottom of each 4 inches by 8 inches, so the weight would not force them into the floor. The ends are 36 inches long, 1 inch by 6 inches, with an angle cast on them with cored holes the same diameter and centers as the side so the same bolt assembles all parts. All of the above pieces were cast in open sand. The pig mold or chill is 29 inches long inside, 5½ inches wide at the top, 4¼ inches deep, the bottom round on a radius of 1¾ inches, with a liberal notch in the center, making the pigs easy to break. The metal on sides and bottom is 2½ inches thick, and is sufficiently heavy, standing the service satisfactorily. The trunnions are 2½ inches in diameter, with an extension 2 inches long on one end and 1½ inches square, to receive the wrench for dumping the pigs from chills.

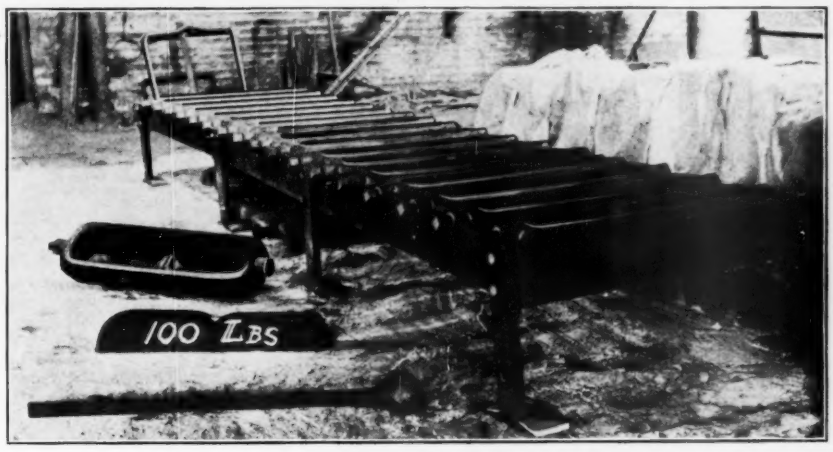


FIG. 2.—PIG AND MOLD.

This bed contains seventeen chills. Making this pattern and molding the chills was nine-tenths of the labor cost. In doing this part of the job, have pattern made to core out the inside and see to it that cores are nicely blacked, making the inside as smooth and sound as possible, with lots of draft so pigs will drop free. We do not black wash or oil our chills, simply fill what we have use for and next day dump them out and have a nice, smooth lot of pigs for our result, instead of a batch of unsightly, dirty pigs and chunks cast in holes in the ends of sand heaps.

We are also using this to get borings into our mixtures to close the grain. The operation is simple and eliminates the trouble and expense of packing boxes. Fill a chill one-half full of borings and provide a laborer with a bar ⅝ inch in diameter and 5 or 6 feet long, 6 inches of which has been bent at right angles to the handle. As the iron is being poured into the chill, gently work the hook back and forth in the pig. This mixes the borings into the mass, so it is charged next day thoroughly incorporated with the remelt pig.

The size of pig bed required depends on the remelt or over run ordinarily expected, which should be as little as possible, unless it is desirable to do as we are doing, that is, run a heavy remelt intentionally, to favor a special mixture the next day, with a given per cent of this iron.

A summary of the costs of this item of equipment which will no doubt interest all foundry managers is herewith given:

Labor cost of rig	$18.25
Material	56.18
Total	$74.43

Former expenses, three hours a day at 17½ cents, for tempering sand and forming the pig bed with a pig pattern, 300 days, $157.50.

This is eliminated and taken as a shop investment, pays 47 per cent.

THE PATTERN SHOP

SEGMENT WORK.

By H. N. Tuttle.

While the laying up of segment work is about the most common operation in a pattern shop, it is a subject seldom discussed in a trade paper. This should not be so, since any scheme which improves or shortens work done often and by many, even if the improvement be small, is of more importance than one which is even a much greater improvement upon work done seldom, or used by few. And although it seems, at the first glance, as if every one knows how to lay up segment work, yet upon further reflection, it will be recalled that almost every pattern maker has some unusual method of doing part of the work, which is different from what might be called the regulation way, and in all probability he has some reason for his hobby. In this article there will be discussed a few of the schemes which are often used, and while it is certain that all of them will not be new to anyone, it is hoped that some of them may be new to, at least, many.

When beginning a piece of segment work, the patternmaker usually wishes to know, first, how many courses there will be, and of what thicknesses. A segment scale is a very convenient instrument to assist in determining these questions, as it saves all computations, and shows at a glance, just what the workman wants to know.

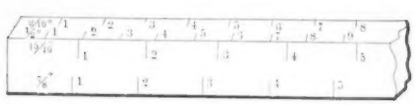


Fig. 1 The Foundry

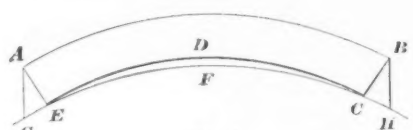


Fig. 2 The Foundry

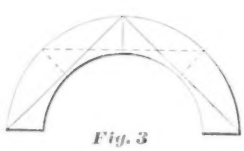


Fig. 3

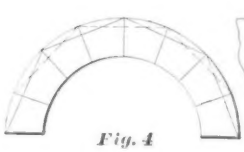


Fig. 4

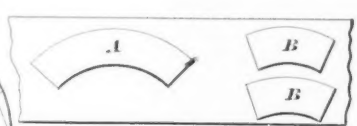


Fig. 5 The Foundry

The scale may be made of a piece of hardwood, about ¾ inch square, and 18 inches or 24 inches long, spaced upon each corner into equal divisions, these divisions being numbered consecutively from one up to the end of the scale. (Fig. 1 shows one end of the scale.) Eight separate spacings may be made upon one square stick, each scale, of course, representing a different thickness of segment. The one shown in the illustration is scaled for ½ inch, 9-16 inch, ⅝ inch, 11-16 inch, ¾ inch, 13-16 inch, ⅞ inch and 15-16 inch segments, though these might be changed according to the requirements of the shop, or two or more scales made. To illustrate the

convenience of the instrument, we will suppose that the patternmaker is required to lay up a ring which is to finish 8 13-16 inches high, and wishes to use segments about ¾ inches thick. He can lay his scale upon his rule, or his layout, and see, at once, that if he uses ¾-inch segments he will need twelve courses, and will have 3-16-inch stock for finishing; while if he uses 11-16-inch segments, he will require 13 courses, and will have ⅛-inch left for finishing. However, if he wishes to use ⅞-inch segments, he will see at a glance that he will have to plane them a little full to make 10 courses fill out.

It is very essential to have the planer working nicely, not only to save all hard planing, but so as to make it possible to lay up the work stair-fashion, which gives a better chance to size the end grain of each cant, if desired, and which is necessary in a method of laying which will be described shortly.

When making a pattern for marking out the segments, if the circle be at all large, it may be made as in Fig. 2. A B C D E shows the segment as ordinarily made. Instead of cutting to the line E D C, lay out E F C, which has the same radius as arc A B, and cut the pattern to this line instead. In marking off the segments, a space equal to the thickness of the saw kerf should be left beween them, though it is not necessary to draw the double line, merely cutting outside the arc A and B each time. In this way, sawing the outside arc of one segment saws the inside arc of the next one. This way of cutting is only profitable with the larger circles, and short segments, as it leaves more timber to be turned out, unless a carriage lathe be used, in which case it is profitable for all circles, as with a good carriage lathe, the stock may be turned away much more rapidly than it can be sawed.

As a rule, it is better practice to divide the circle into many short segments, rather than into few long ones, for several reasons. The most important is that the grain of the wood in the adjoining layers, crosses at a less angle where many short segments are used. This is shown in Figs. 3 and 4. Fig. 3 shows a pattern laid up with four segments to the circle. Fig. 4 shows the same pattern with eight segments. The full lines show the direction of the grain in one course, while the dotted lines show the same thing in the course above or below. This greatly affects the life of the pattern, as the shrinking and swelling of the wood in Fig. 3 will tear the glue joints long before it will in Fig. 4, other things being equal. There is also less waste in cutting up the lumber, as shown in Fig. 5, A being one segment of Fig. 3, while BB are two segments of Fig. 4. Another advantage is that the work turns better, as the cross grain does not tear out so badly on the inside, at the end of the segment.

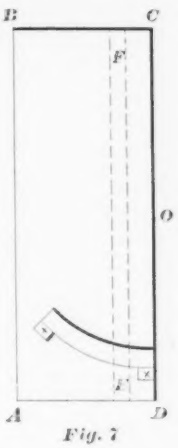


Fig. 7

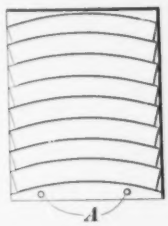


Fig. 6

The Foundry Fig. 8

This tearing out tendency may be reduced by sizing the end grain of the segments while gluing up, and also by trimming the ends in such a way that the segments will bind a little on the inside edge.

When sawing several layers at once, only two nails should be used in each row of segments, located as shown at A Fig. 6, so that after the segments

are sawed, there will be no nails to draw. All the ends should be sawed first, and then the arcs, thus saving the turning around of the work for each segment. If several layers be sawed at once, it is better to nail each layer to the one below it with short nails, rather than nailing through them all at once with long nails, as there is less liability of the nails turning and getting into the path of the saw.

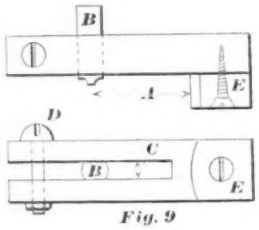


Fig. 9

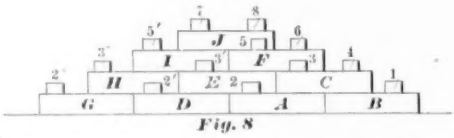


Fig. 8

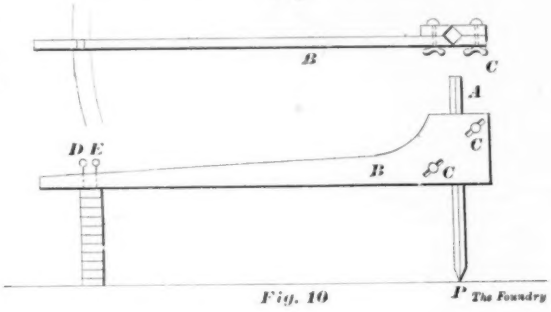


Fig. 10 The Foundry

If the ends of the segments are to be finished on a trimmer, they may be sawed to the lines AE and BC, Fig. 2, leaving enough stock for trimming. Many patternmakers, however, prefer to trim the ends on the cut off saw, as being much quicker, and in this case the ends are not band-sawed at all, but left as at A G and B H, Fig. 2.

An easily made rigging for this work is shown in Fig. 7. A B C D is a board with a cleat E F nailed on the bottom to slide in the groove in the saw table. Cleat E F is fastened on the board in such a position that the first time it is run over the saw table, the edge C D is trimmed by the saw. This brings C D exactly in line with the saw cut. From some point on C D with the trammels set at the outside radius of the segment, an arc is struck, and the length of the segment measured off from C D. Two blocks are nailed tangent to this line as shown at X X. In use, one end of the segment is sawed, and reversed. The finished end is now brought flush with the left block, X, with the left hand, which insures the segment being cut the right length. This block should be located so as to cut each segment a little long, as it is impossible to cut them so as to lay up exactly, without fitting the last piece. The board is quite convenient, too, in fitting the last piece, as it is only necessary to mark the length on the segment, using the board to get the proper angle. If a sharp cut-off saw be used, with scarcely any set, the ends will be as well finished as if done on a trimmer. It is not a very essential matter to have a good glue joint at the end of the segments, as it does not practically increase the strength of the pattern, and some patternmakers never put glue on the end joint at all. As its only advantage is in the turning, as previously mentioned, it would not be a very serious matter, should the ends of the segments be left a little fuzzy, which will be the case if the saw is not sharp. In laying out the board, the trammel edge center, shown in Fig. 8, and described in the *Patternmaker* two years ago, is a very convenient tool.

The table of the largest size Fox trimmer, since January, 1906, has a chart laid out upon it for locating the proper position for a gage for cutting segments for any sized circle, of

3, 4, 6, 8, or 12 segments to the circle.

The segments being finished, the next question to decide will be the method of gluing up. If it is not advisable from the nature of the pattern to leave nails or pegs in it, there is probably no way of clamping the larger circles as good as the use of hand-screws, though if one has to

There is no exact limit to the number of courses that can be glued and clamped by this method, but it should be few enough that the glue will not be set between any two segments before the next tier is clamped. For instance when segment H is placed in position, A is clamped by 3^{11} removed from 3^{1}, on segment E. E is now clamped only by 5,

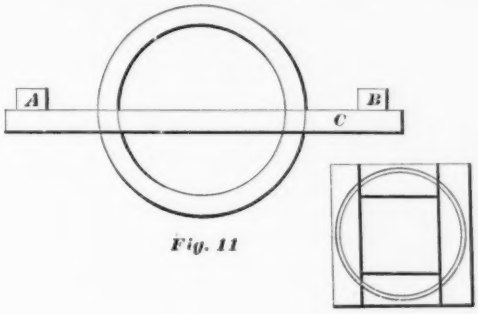
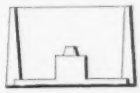


Fig. 11

Fig. 12



Half Pattern of Pulley
Fig. 14

Fig. 13

wait for each course to dry before gluing on the next, it is a rather slow operation. In Fig. 8 is shown a method of gluing and clamping several layers at once, thus reducing the waiting to a minimum. The figure is not drawn to scale, and shows the side view of the circle, unrolled for convenience in illustrating. Two men should work at this, one man gluing, and the other manipulating the clamps.

Segments A and B are sized at the end, and placed in position, using dogs if desired, with clamps 1 and 2 placed as shown (the squares with the numerals inserted are meant to represent the upper jaws of the hand-screws.) Segment C is now glued and held by clamps 3 and 4. D is next sized, placed in position, and clamp 2 removed to position 2^{1}. Segment E being glued, it is placed in position, where clamp 2 was before being removed for clamping D, and held by removing 3 to 3^{1}. F is then held by 5 and 6. Likewise segment G is held by 2^{1} removed to 2^{11}, H by 3^{1} removed to 3^{11}, I by 5 removed to 5^{1} and J by 7 and 8.

over F, and if it has any tendency to curl, it may break the glue underneath, if it has slightly set. From four to six courses may be nicely managed by two men, the clamps being all properly adjusted before beginning operations. To give some idea of the time required for this way of clamping, a cherry gear wheel, 44 inches diameter, five segments thick, 12 segments to the circle, was glued and clamped by two men in 15 minutes. This is probably faster than the pattern could be nailed up.

It will be noticed that the segments are made short, perhaps about eleven inches long. If long segments be used, four clamps should be placed on each, but it is generally more convenient to use the short segments.

Where the pattern is small, and to be used but temporarily, the segments are often merely laid up in glue as rapidly as possible and the whole covered with a round board and weighted down with old castings, or the cover may be held down with a lag screw in the center, or a bolt, or any cheap clamping device. Another way is to toe-nail the segments together, the nails

being withdrawn after the glue is dry. Sometimes where it is not permissible to leave nails in the pattern, the clamping is done with leather-headed nails. The nails are made by cutting up old belting into small square pieces, and driving through them, common flat-headed carpenter nails. After the glue is set, the nails are withdrawn and 3-16 inch dowel-pegs put in their places, drilling for them, of course, and glueing them in. This is a good way where a large thin rimmed wheel is to be made, where some of the nails would be nearly certain of coming out into the turning, and where the support of the pegs is necessary to withstand the continual hard foundry use. A large traction engine drive wheel would be an example of such a pattern.

Generally, though, segment work may be nailed up, care being taken to place the nails so they will not turn out, nor be in the way of any subsequent cutting.

There is a certain variety of nails, called by carpenters "rosined nails," which have a common flat head, but are made of a finer wire than the regular carpenters' nails. They are very good for nailing up segment work, as they do not split the wood as much as the common nails, yet on account of their rosin coating, they have as much or even greater drawing effect.

For rather thin rings a line is often scribed on the segments for setting the nails. While this may be done with a hermaphrodite caliper, a more convenient tool is shown in Fig. 9, in which B is a short pencil, flattened on the sides to fit slot C, and be clamped in any position by bolt D. E is a metal lug curved on one side to easily run over the irregularities of the sawed edge of the segment. The distance A is adjusted to equal the distance of the nail line to the outer edge of the segment. If a carbon copying pencil be placed in this gage, several hundred segments may be marked with it without resharpening.

When segment work runs up to any height, or if the pattern is to be turned down quite thin, it is essential that the work be carried up square.

One way of doing this is to strike a check circle on the board on which the gluing is being done. From this circle lay out a new center every few courses, from which center a new circle is struck upon the face of the work.

In some cases a center stud is erected square with the bottom board. A very convenient tool for keeping the work plumb is shown in Fig. 10, which for want of a better name will be called a nail trammel. A is a square leg sharpened at one end with a metal point inserted (a brad will answer well enough). This leg can be moved up and down at right angles to the beam B, and may be clamped at any position by the thumb-nuts CC.

D and E are two wire scribers. In setting this tool for use, leg A is raised till point P is even with the bottom of the work, PE is then measured off, equal to the radius of the circle in which the nails are to be driven. PD is measured so that D will scribe a line about 1-16 inch outside the finish of the pattern. In laying up the segments, they are always set so that they will fall outside this line scribed by D.

Of course it is necessary to fit the entire course of segments, holding each with two nails driven partly into the course below, before the lines are scribed.

As each successive course is nailed on, the trammel beam is laid on the work, and the point P dropped down to the bottom board, so that the beam will always be level when in use.

When the work is to be split in halves on a bandsaw if it is also to be carried up to some height, as in large valves, it is convenient to erect a perpendicular stick on either side of the pattern, a few inches away, and on the center line where the pat-

tern is to be sawed. The top view of this case is shown in Fig. 11. AB are the perpendicular sticks and C the straight edge used for marking the joint line across the work.

Small pulley patterns, where the metal in the rim is only about ¼ inch thick, do not mold very well, if laid up in the ordinary way, as the segments from shrinking and swelling soon make a rough drawing surface. If the patterns are made with the grain running up and down, they will draw much better, and are also easier to glue up. One way of glueing is shown in Fig. 12.

On account of the weakness of the pattern made in this way, its edge should be bound together as shown in detail in Fig. 13. The targ end of a file is ground down, so that it will cut a groove just twice the thickness of the sheet zinc ordinarily used in a patternshop. The groove is turned in about ½ inch deep as shown, and a strip of zinc running twice around the pattern is inserted, fastened and the edges trimmed while in the lathe. In doing this, care should be taken to avoid a smash.

When turning segment work, a tooth plane is a very convenient tool to use, as it does not have the tendency to gouge into the work as a flat chisel does, neither does it leave the surface as wavy as the flat chisel. It should have a good firm handle clamped on it, which may be removed for turning small internal work.

While the mortising in of gear arms does not exactly fall in segment work, yet it is so closely connected with it that it might not be out of place to mention in this article a way of doing this, by which the mortising is all done on the band saw, and which makes a more solid job than the customary way of notching in the bead on the inside of the rim, and holding the arms with dowel-pins.

The spider or arms are prepared before the rim is glued. The segments which come in the center of the wheel are made of such thickness that one, two, or three courses will just equal the thickness of the arms where they enter the rim.

When ready to glue up the rim, the arms, minus the hubs, are laid on the foundation board, properly centered, and the segments, beginning at point B (Fig. 15), scribed, and notched out

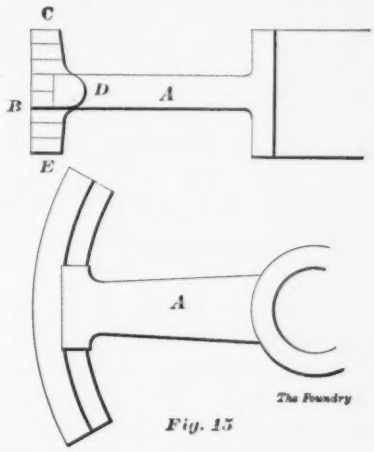


Fig. 15

around them, the cutting being done entirely on the band saw, until the rim is built up flush with the top of the arms. The arms are now lifted out, and blocks dropped in their places, and wedged over to the edge of the mortise which is subject to tearing out when the wheel is turned. The pattern is now glued up to C. The pattern being placed in the lathe, it is finished on face C and on the inside down to D. The work is now taken off, chucked by the inside finished corner, and the turning finished to face B. The pattern is taken from the lathe, still in its chucking, the blocks in the mortises taken out, and the arms dropped in and fastened. The remaining segments are now glued on, the pattern returned to the lathe, and the outside, face E and the inside down to the spokes, finished. If the inside surface between the spokes at D be varnished before the last segments are fastened on, the glue, which will be almost certain to run over it, will be more easily cleaned off.

TIME LOST IN THE CORE ROOM.

Core Box for Four-Step Cone Pulley. —Friction Cone.

By Jabez Nall.

There are many and various ways that time may be lost, or in other words, misspent, not only in the core room, but in all other departments of a manufacturing establishment. We are not referring at this time to the loafer, or to the man who lays down on his job today because some inefficient workman put in a lot of useless and unnecessary labor on the same job the day before, thus setting a false standard of a day's work. Nor do we intend to refer particularly, in this article, to the man who turns out worthless work, which causes loss in some other department; but this is written to impress upon the patternmaker the necessity for a thorough knowledge, not only of the general principles, but of the practical details of the work both in the core room and the foundry. A lack of this knowledge, on the part of the patternmaker, sometimes causes a loss in both these departments, whereas the suggestions of the practical patternmaker have often resulted in a saving in both.

The Progressive Patternmaker.

Most patternmakers are content, after deciding that it is best or necessary that a core be used in the making of a given casting, to let it go at that, without giving thought as to how that core must be constructed in order that it may be strong enough to stand the handling required, from getting it out of the box to placing it in the mold, and to resist the pressure of the metal, as well as to make sure of its retaining its size and shape. But the wise patternmaker will think a little further to see if his method cannot be cheapened, or a better one found for the successive stages of producing the finished castings. In order to do this it is essential that he should previously make a study of the details of foundry practice, as above indicated.

It is an old saying that "if you take care of the pennies the dollars will take care of themselves." This applies not only to the small boy beginning his first savings account, but it applies with equal force to the apprentice or the young patternmaker, that if he will take care of the small cores the large ones will care for themselves. He will have formed the habit of considering the molder's and the coremaker's end of the work, before it comes to him to run through the big jobs in the pattern shop.

As we pass through the foundry, having our eyes open, we are impressed with the fact that some patterns, like men, "are fearfully and wonderfully made." Here are just two or three simple illustrations of the fact that we notice in passing. Some one needed a small core shaped as in Fig. 1, so, evidently with the idea of being good to the coremaker, he constructed the box as shown in Fig. 2, being an open frame box, loose at opposite corners, and a loose bar across the top, doweled in position, and having a piece attached to form the opening through the core. Had he made the box as in Fig. 3, in one piece, with a very slight draft, probably he would have saved half of his own time and given the coremaker something by which he could make the core in less time than he could clamp the box, Fig. 2, together, to say nothing of the time spent tucking around the print underneath the bar, and the extra trouble of sweeping off the top. The result is about four to one in favor of box in Fig. 3.

Four-step Cone Pulley.

Another illustration of our subject that comes to mind is the making of a 28-inch, 4-step cone pulley, as shown in part section to the left of Fig. 4. To the right is shown one way of making the core box for the same. This pulley was standard, often in the foundry, and was made in this way. The core box was made a full circle with a loose ring parted as shown, the hub and four wings being built together, but loose in the box. In making this core it is necessary that it be in two parts, the upper part lifted away to make it possible for the center piece to be withdrawn. The parting is made to conform to the rounded edges of the wings and the top of the hub, the cope print for the center core being taken up with the upper part of

the main core. This leaves the four bodies of sand between the wings disconnected at the top, making it necessary that they be securely rodded to hold them firm. Provision must be made at the bottom of the core, by the placing the lower part, these holes being filled in later by the molder. To do this, in the writer's opinion, is taking a chance of its moving, unless the cope bears hard on the core, as there is no other print for this portion of the core. In either

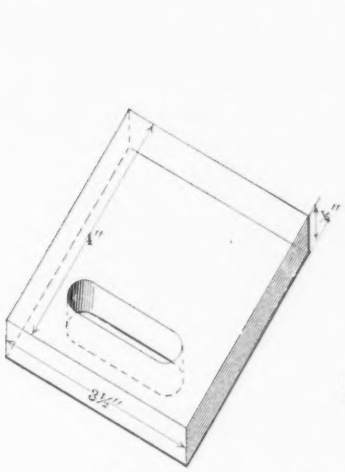


Fig. 1

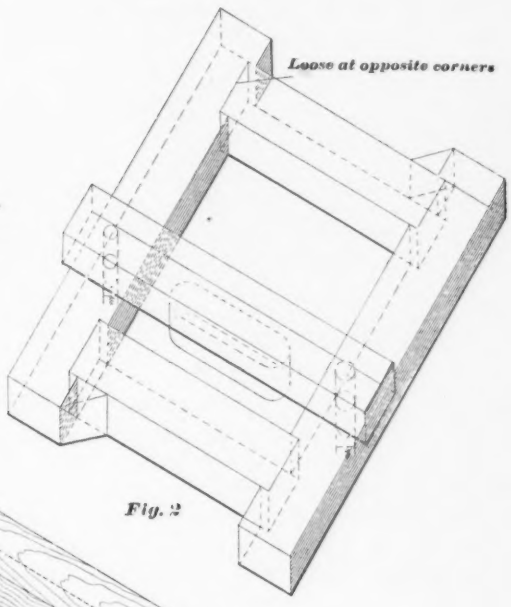


Fig. 2

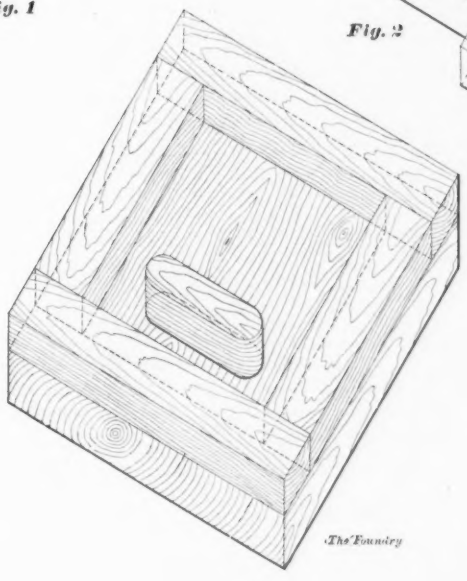


Fig. 3

of circular rods and cross rods as binders for hooks, to fasten the two halves of cores together, similar provision being made in the upper part of core. Some coremakers may take a chance on the paste being sufficient to hold the two parts of core together, holes being put through the upper part of the core to connect with the lifting hooks placed in case it does not affect the point we wish to make, for this upper part of core must at least be built strong enough to be lifted away from the lower part while green. Now all these rods, hooks, etc., do not grow in these peculiar shapes, but must be bent into the form required, and this, of course, takes time, as does the making of the parting and the making of

practically two cores where one would do, to say nothing of the pasting and securing together of the cores when dry.

Another Method.

Fig. 5 shows another method of making the same core. This shows the hub and wings separated, the wings being fitted into grooves at the hub and inner rim of core box. The ring or body of core box may be made full or in halves, as is thought best, the writer preferring the latter method, as it is then possible to make the core directly on the drying plate, thus preventing its rolling over occasionally when dry before placing in the mold. This is, of itself, an important consideration in core making. Four pieces should be screwed on box, as shown at A, for clamping together. The hub of the pulley can be turned with a print of larger diameter attached to its cope end, or a cast iron print may be made with a pin of standard size on the under side, fitting to corresponding hole in the hub as shown at B, Fig. 5. This could then be used with different pulleys having hubs of similar or smaller size. A cast iron core box, being made to fit this print, as shown in Fig. 6, having a hole drilled for interchangeable prints for center core. This core takes only a few minutes to make and is a boy's job at that.

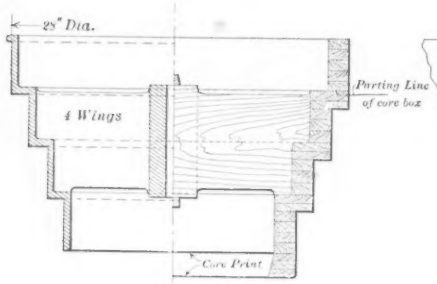


Fig. 4

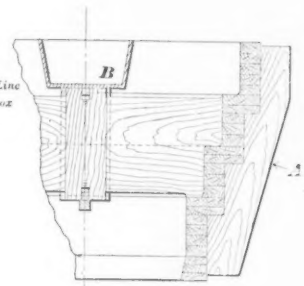


Fig. 5

Fig. 6

The four loose wings may be made of wood and serve the purpose for a time, but their life is short, and for a standard pulley, of which very many castings are expected, they should be of metal and finished up. The main core by this method can be rammed right up to the top and needs little rodding beyond the binding of the lifting hooks and a few hooked rods, or gaggers, that can always be found at hand. The core being made thus far, the print B is removed and the hub withdrawn, the outside of box removed and the wings drawn from the outside. The writer would prefer leaving the setting of the center and covering cores for the molder though, of course, it could be done in the core room, but if left for the molder, he has

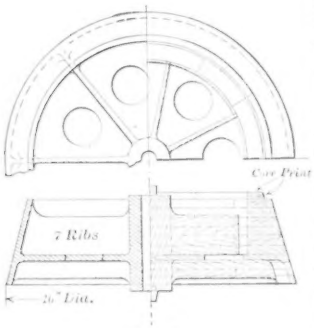


Fig. 7

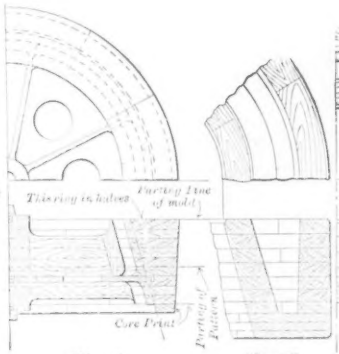


Fig. 8

Fig. 9

Fig. 10

a chance to examine his core and to blow out any dirt or dust prior to placing it in the mold. This method shown in Fig. 5 will result in a saving of at least 150 per cent of time in the core room over that shown in Fig. 4.

Friction Cone.

Another illustration of time lost in the core room is indicated in Fig. 7, which shows a 16-inch friction cone with seven ribs and a center web connecting the hub to its outer rim. This is shown in part section to the left, while to the right is shown one method of making the pattern for same. Now, strange to say, this idea the patternmaker was not to blame for, but the foundry superintendent, who kicked hard for his own idea when the patternmaker replaced it with the one shown in Fig. 8. Incidentally this shows what the patternmaker gets by consulting with the foundry superintendent. Fig. 4 shows the pattern made to core out the inside of the rim, which overhangs the center web of casting. Through this core it is necessary that the metal for the seven ribs be continued to the rim of wheel ,

In the first place note the thickness of the metal at this point, 3-16 inch, and the accuracy of the work required of the patternmaker in matching these ribs in the core to those on the pattern and the time required to make such a box, shown in part section and plan, Fig. 10. Then remember that no matter how careful he has been in the wood work, these must later match in sand, one portion of which is soft and green and the other portion baked in the oven, with the probability, almost certainty, in fact, that some of the corners are slicked back or broken off, to say nothing of the fin, left in placing the core in the mold, be it ever so small, the result will inevitably be a badly scarred casting. Another thing that needs attention is the small opening through which to ram the core and place all necessary wires or nails to secure the same, and the small section of core sand above the ribs connecting these seven parts of the ring together, and the careful work required of the coremaker to secure these safely and make a core strong enough to handle.

By reversing the method of molding, as shown in Fig. 8, parting the pattern as shown and cutting the upper ring in two halves, these being lifted with the cope and drawn sideways, we have the interior of the casting made entirely of green sand and any blemish or scar on this portion of casting must be charged to the molder, while the core, a plain taper ring, Fig. 9, being on the outside of casting which is finished in the machine shop, cannot cause any defect on the casting. This box, Fig. 9, can be made solid and is all lathe work. By this method we have a cheaper and stronger pattern with an equal result in molding and a saving in the core room of at least one-half.

USE OF LIQUID GLASS.

By Robert H. Palmer.

If any one will take a piece of shafting and coat it with liquid glass and place it in a pig bed, or any mold where he can see some melted iron poured into the mold, and flow up around and over the shaft, I think he will be surprised to see how easily the iron will lay to shaft. Keep the bottle containing it well corked, and wash the bottle after using in hot water. If the bottle is left open the liquid will quickly harden. If the liquid glass is allowed to collect on the sides of the bottle, there is danger of cut fingers in handling.

CINCINNATI INDUSTRIAL BUREAU DINNER.

The annual meeting and banquet of the Cincinnati Industrial Bureau was held at the Business Men's Club Jan. 21. William Lodge, of the Lodge & Shipley Machine Tool Co., presided. The object of the bureau, briefly stated, is to secure the location of industries in Cincinnati by assisting in finding sites for new plants or plants contemplating moving. The report of the secretary brought out the fact that the past year has been one of such great prosperity that but few plants have had time to consider changes, and under the pressure of active business were content to remain where they were.

BRASS FOUNDING

THIS DEPARTMENT IS DEVOTED TO THE TREATMENT OF ALL ALLOYS INCLUDING THEIR

FOUNDING, GRINDING, POLISHING, ELECTROPLATING ETC.

BRASS FOUNDRY COST ACCOUNTING.

D. CARL EGGLESTON, M. E.

Authorizations for doing work in the brass foundry are issued by the material order department on Form 1. The date, pattern number, quantity of castings required and mixture from which they are to be made with the shop order number and name of part for which they are used are entered on the order. To each standard mixture a number is assigned. Thus hard metal may be designated as No. 1 mixture which consists of:

60 pounds copper.
12 pounds sheet brass.
4½ pounds tin.
2¼ pounds lead.

In brass foundry cost accounting the aim is to find the cost per pound of castings made from each mixture. If the records are revised monthly the work of analyzing the cost of jobs where brass foundry castings are used is facilitated and accurate results are assured.

Raw material is drawn from store rooms on raw material delivered slips Form 2. These requisitions are made out in duplicate and signed by the foreman. The foreman keeps the duplicate and the store keeper forwards the original after delivering material to the material order department to use in posting the amount of material drawn from stock to their records. The foreman has a set of cards one of which is reserved for each mixture

FORM NO. 46 E. S

ORDER ON BRASS FOUNDRY.

PATTERN NO. _____ DATE _____ 190___

MAKE _____ CASTINGS.

USED ON _____ FOR S. O. NO. _____

DELIVERIES TO STORE NO. 1.

DATE	QUNATITY	DATE	QUNATITY	DATE	QUNATITY	DATE	QUNATITY	DATE	QUNATITY

FORM 1.

The Foundry.

made on which he enters the kind and quantity of material drawn from stores; also the castings and gates made. The invoice, of course, exceeds the output as there is always more or less waste

Labor in the brass foundry is divided according to the classes of work done, machine, die, tub and general being the usual divisions. Daily the foreman makes a report of the men employed in the foundry and after each man's name he indicates the class of work on which he is engaged and the number of mixtures used. The time of men charged to the "general" class of work is later divided on the basis of the time charged to the other classes of work.

If the brass foundry is located in a large plant it is best to make transfers of fixed charges, power, rent, tools, administration and sundry expenses to the brass foundry expense account. An analysis of the items in the account shows that they are either incurred in equipping and maintaining a suitable place for doing work or in connection with receiving, handling and storing material. The former division is called "labor expense" and the latter "material expense." The basis for dividing the fixed charges expense, depreciation, insurance and taxes, is the value of the machinery, fixtures and tools used. All racks, shelves and partitions of a temporary nature are included under the head of fixtures. The amount of fixed charges on those used in connection with receiving, handling and storing material is chargeable to the material expense division The rent expense charge made up of fixed charges on building, repairs changes meaning and sweeping is prorated on the basis of floor space occupied. That used for storing raw and worked material is chargeable to material expense and the balance to labor expense. But few tools and supplies are used in connection with material, the major part being distributed with the other items of expense not chargeable to material to the various classes of work done. Thus the indirect expense account of the brass foundry is divided between material and labor, the latter division being subdivided between machine, die and tub work.

The purpose of such a careful division of material, labor and expense is to facilitate the accurate finding of costs. The material expense for any period is prorated to the mixtures made on the

Form 4 B.S.

RAW MATERIAL DELIVERED

FORM STORE NO. 6

KIND Copper

SIZE

QUANTITY 60 #

ORDER NO.

BRASS FOUNDRY DEP'T.

FOREMAN M. LINDNER.

DATE 7-1-06

DELIVERED BY	CHECKED BY
KF	JWB

ENTERED BY

MATERIAL ORDER DEP'T.

THIS COUPON MUST BE SENT TO THE MATERIAL ORDER DEPARTMENT WHEN STOCK IS DELIVERED.

FORM 2. *The Foundry*

basis of the value of material used in each. The labor expense is distributed to classes of work as explained which gives the lump sum for a period chargeable to machine, die and tub work. In each case this sum is distributed to the various mixtures made on the basis of the weight of castings produced. Thus, in the former case we have a percentage plan and in the latter a rate per pound for distributing material and labor expense respectively.

The work of figuring the cost per pound of each mixture made is not

so difficult as it might appear to be. Certain mixtures are usually made by die work, others by tub work and so on. From the entries of material on the foreman's cards the kind and quantity of material used for each mixture is obtained for any period desired. After obtaining prices the cost of metal used is easily found. The proper per cent for material expense is then added, thus giving the sum of the direct and indirect expense of material used. In each case credit is of course given for gates left over. The foreman's labor report furnishes the basis for assessing the various mixtures with productive labor. To this must be added labor expense which is done by multiplying the weight of castings in pounds of each mixture by the proper rate per pound. For machine and die work the rate is usually about .05 per pound and for tub or floor work about .06 per pound. The analysis of the cost of a mixture is shown in Table I:

Table I.

Class.	Weight.	Cost.	Prod. labor.	Rate per lb.	Load. ing.	Total.
Tub	1,000 lbs.	$142.00	$17.40	.06	$60.00	$219.40

The cost includes that for material plus three per cent for expense. Productive labor is that assessed directly against the job. Loading is the charge for labor expense. The total dividend divided by the number of pounds of castings made gives the cost per pound which in this case is $0.219.

Several years of experimenting has resulted in developing the system herein outlined and its use has produced accurate results. Not only are current costs scientifically found but data is obtained that furnishes a sound basis for making estimates. The knowledge that the exact cost of all deliveries to the piece parts account is accurately known is also of great value. Though brass foundry cost accounting has not received the same amount of attention that has been devoted to other departments of factory accounting, it nevertheless deserves just as careful consideration.

BRASS FOUNDRY NOTES

BY C. VICKERS

METAL PATTERNS.

Question:—Can you furnish me with a mixture for brass castings used for metal patterns, a casting which will work easily and not be too soft or too hard? I sometimes have to use scrap brass in my mixture, so perhaps you can give me a mixture with and without scrap brass.

Answer:—The following mixtures will answer the purpose: New Mixture, (1), copper, 80 pounds; zinc, 6 pounds; lead, 5 pounds; tin, 4 pounds. (2). Copper, 70 pounds; yellow brass, 20 pounds, tin, 3 pounds; lead, 4 pounds.

Clean scrap brass, 50 pounds; copper, 40 pounds; zinc, 7 pounds; lead, 3 pounds.

The hardness of any of the above alloys may be varied by an increase or decrease of the tin.

BRONZE STATUARY.

Question:—Would you please give in an early issue of THE FOUNDRY a good mixture for bronze statuary, also a mixture for fine door trimmings, such as door pulls, push plates, etc.?

Answer:—The following alloy will answer for both purposes: Copper, 64 pounds; tin, 4 pounds; zinc, 1¼ pounds; lead, 1 pound.

THE WEIGHT OF BRASS CASTINGS.

To determine the weight of a brass or bronze casting, the easiest way is to weigh the pattern, and multiply the number of pounds of wood (pine) by twenty which gives the weight in metal.

To find the weight of a cylinder of bronze, multiply the height by the circumference, and the product by five, this gives the weight in ounces, of such a cylinder one inch in thickness.

A cylinder or bushing, 60 inches in circumference and 30 inches high by one inch in thickness, would weigh about 560 pounds, and would need at least 600 pounds of metal to pour it. If it were only ½ inch in thickness, we

should be obliged to melt 300 pounds of metal to safely pour it. This method of figuring gives a little more metal than the casting would take, but it is always best to err on the right side and melt a little more than is required.

BRASS SHELLS FOR PAPER MILL ROLLS.

Question.—I would like to know if you can give me any information in regard to making brass shells for paper mill rolls. I am making them and am having a little trouble in making some of them, that is, they come porous. The holes are clean holes, some are large and some are small. I think they are holes caused by gas or the temperature of the metal. I have melted the metal in a cupola and also in an oil furnace and have the same results. They sometimes come dirty, which I think is caused by blacking coming off. I run them from the top with pop gates. They vary in size from 10 inches in diameter to 20 inches in diameter, and 144 inches long. The metal is about ¾ inch to ⅞ inch thick. The mixture I used is 65 per cent pig copper and brass, 30 per cent zinc and five per cent tin.

My mold is thoroughly vented. The outside looks nice in the rough, but when they are turned up they have the clean holes. That is, these holes show no dirt in them, and some are dirt holes, which shows that they come from the core scabbing a little. My core is made in loam, that is, it is made on a pipe, according to the size of the core wanted. The pipe is full of ½-inch vent holes and rapped with hay rope and the mixture of sand for the core is two parts of coarse molding sand No. 3, one part of No. 1 fine molding sand, one part of Jersey fire sand and one to 40 of flour.

My mold mixture is three parts of No. 3 coarse molding sand and two parts of No. 1 fine molding sand and two parts of old sand and one to 40 of flour. My blacking mixture is one pint of molasses and three gallons of best plumbago, and I have tried 1½ parts of charcoal and 1½ parts of mineral and three parts of plumbago. Let me know what you think of this. Some think I do not pour the metal hot enough. I think I might have better results by pouring them dull as I can get the metal to run them. I have got some of them, but not as perfect as I would like to have them. They have to be perfectly clean.

The shells that I make are cast on end with pop gates. About four gates 1¼ inch wide by ½ inch thick on a 12½-inch shell with two vents taken off of the top of the mold.

I have also used a mixture of 15 per cent pig copper, five per cent wire cloth, 30 per cent good chips and 50 per cent brass scrap.

Answer—Here we have a class of castings which must be without a flaw when they are machined to size. A small hole or speck in one of those shells would cause serious damage in the paper manufactured. In ordinary circumstances it requires considerable skill and care to produce perfect castings in any metal, but with brass and alloys it takes extraordinary vigilance to insure perfection in heavy sand castings such as these. Let us examine this firm's methods to find out where they fail and how they can be improved. It is evident they are molders, as their method of making the mold and pouring same is quite correct, but their melting practice is bad on the face of it. They "have melted the metal in a cupola and also in an oil furnace with the same results." I should expect they would always get unsatisfactory results from either furnace, for work of this description.

Yellow brass cannot be properly melted in a cupola, or for that matter in any kind of blast or forced draft furnace. What is wanted for this job is a small reverberatory, or else a number of natural draft crucible furnaces, say six, each one to hold a 300-lb. crucible which can be emptied into a

hot ladle when all other preparations for casting are complete.

Two distinct troubles are admitted with the castings that have been made: First, they are porous, and second, they contain small dirt holes. Unfortunately neither of these faults can be discovered before the castings are machined. The cause of the first fault, porousness, is undoubtedly gas, while the second fault is evidently due to the blackwash peeling off when it is attacked by the heat of the metal. Experience has proved that the best plumbago in the world is of little use as a covewash if it is not mixed with a suitable bond.

Molasses makes quite a suitable bond for light work or where the mold can be quickly filled, but for a job like this, where the metal has a drop inside of the mold of 12 feet, a better wearing and more refractory bond is required. Clay answers both of these conditions and the easiest way to mix it in blackwash is: Make a stiff paste of plumbago with thick claywash, dilute this with an equal bulk of water and pass through a hair sieve. With this mixture you have a combination of the best refractory and the strongest bond for high temperatures, and by brushing over the mold with molasses-water (that is, after it has been blackwashed) a hardness is important to the skin. Flour figures in the sand mixtures given. No doubt flour is an excellent mixer for core sands and light molds; for heavy work it is too combustible and most of the trouble with the shell arises from the gas producing materials in the molding sand and in the cores. I would therefore advise that the flour be omitted. For the cores make a strong loam as follows:

Take six parts coarse sharp sand and one part good molding sand, pass it through the quarter riddle in a dry heap, form a basin with it, into which pour sufficient claywash to mix like thin mortar. Cut this over repeatedly with a slice or a shovel on a plate. In about 15 minutes you should have a good, adhesive, hand-made loam, suitable for the finishing coat of your core. The loam for the first coat may be made from floor sand mixed with water to a "skilly," but it is necessary to have not less than half an inch of the strong loam on the outside of the core.

The sand mixture stated for the mold is quite good enough, but by all means leave out the flour. Do not slick either the mold or the core; simply blackwash the finished mold with a camel's hair brush, followed by a touch of gum or molasses water, and make sure that both mold and core are thoroughly dried. Skin drying will not do for this job; in fact, the runner basin should be made up, blackwashed and dried along with the mold.

The metal should certainly be hot; dull metal would only increase the risk of porousness, more especially with the mixture which has no tin. I have made similar castings for a paper mill in Dalkeith (Scotland), from the following mixture: Copper, 20 parts; brass, 10 parts; tin, two parts; lead, one part. If the extra expense of this mixture can be borne I can recommend it. In pouring the metal see that the head is kept full while the mold is being filled up. Your failure has been due to using sand mixtures which are only fit for light work and furnaces which are quite unsuitable for melting volatile metals. Don't be afraid of a bit of claywash. A barrel of blue clay soaked in water is a good friend to the molder of heavy brass work—if he knows how to use it. Then, if you must melt the brass in the cupola or other forced draft furnace, put all the copper in the first charge, and after that is melted reduce the blast and charge the brass, zinc, etc., in succeeding charges. You shall then be more successful.

J. F. BUCHANAN.

FOUNDRY AND PATTERN SHOP APPLIANCES AND SUPPLIES.

Continuous Sand Mill—Curtis Traveling Crane—New Line of Controllers—Snap Molder's Bench.

TRADE NOTES.

A continuous sand mill Fig. 1, designed for thoroughly preparing sand for foundry use, and which accomplishes the mixing, rubbing and screening, is manufactured by Ph. Bonvillain & E. Ronceray, Ingenieurs, Paris, France. The mill consists of a revolving barrel slightly inclined

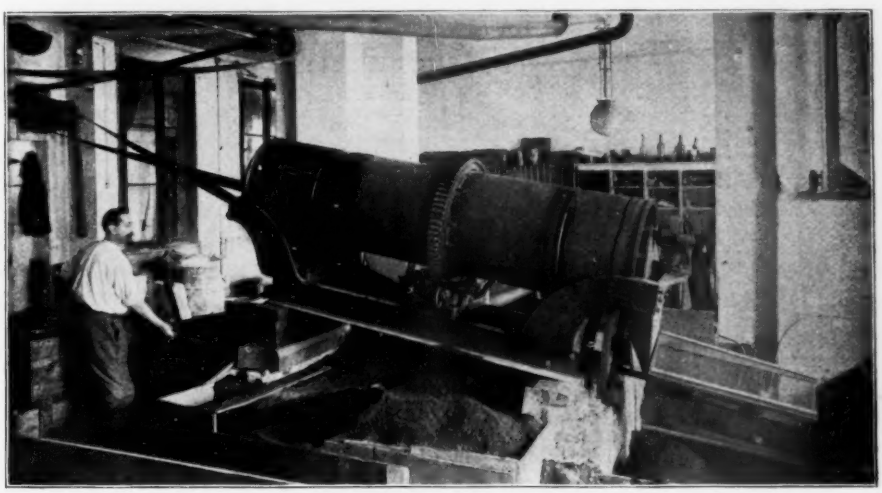


FIG. 1.—CONTINUOUS SAND MILL.

mounted on two pairs of wheels. The barrel, Figs. 2 and 3, is divided by a cross partition in two chambers of unequal lengths, the upper one being utilized for mixing and the lower one, which is the smaller, for crushing and working the sand. Into the first chamber the sand is either shoveled by hand or delivered by some mechanical device, after having been previously roughly mixed and moistened, either by hand or by some mechanical arrangement. After being thoroughly mixed in the first chamber it is carried by adjustable spoons and projected through an inclined plate into the working chamber, which is made in varying lengths according to the quality of sand used and required, and is fitted with three rollers of different diameters, which revolve as the result of the revolving motion of the barrel, but at different speeds, owing to the variation in their sizes. This chamber is clearly shown in Fig. 2. After passing between the rollers, the sand adheres slightly to the barrel and is scraped off by means of a flexible sheet of steel mounted on a beam pivoted at the ends. This scraper forces the sand to fall and to be rolled over again, and owing to the inclination of the chambers, the sand is moved slowly towards the lower end of the barrel at a speed depending upon the incline of the barrel, which is determined for each foundry and depends upon the quality of the sand required. The scraper is held against

the wall of the barrel by a counter weight, the wear on the sheets being taken up in this way. The barrel is turned at both ends, and the lower opening rests against rollers arranged ready for use. The barrel is operated by means of a gear, pinion and fast and loose pulley, arranged to be driven by a main shaft, either parallel or perpendicular to the barrel axle.

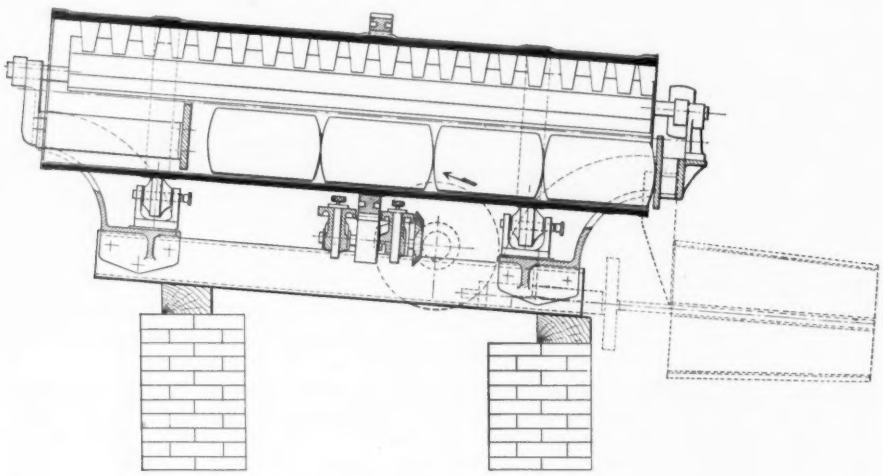


FIG. 2.—CROSS SECTION SAND MILL.

to take the thrust. This opening is partially closed by a strong plate supported by a bracket, which receives the thrust of the rollers and which supports the lower end of the scraper

A DOUBLE I-BEAM TRAVELING CRANE.

A double I-beam traveling crane with pendant hand chain on bridge and trolley, manufactured by Curtis & Co. Mfg.

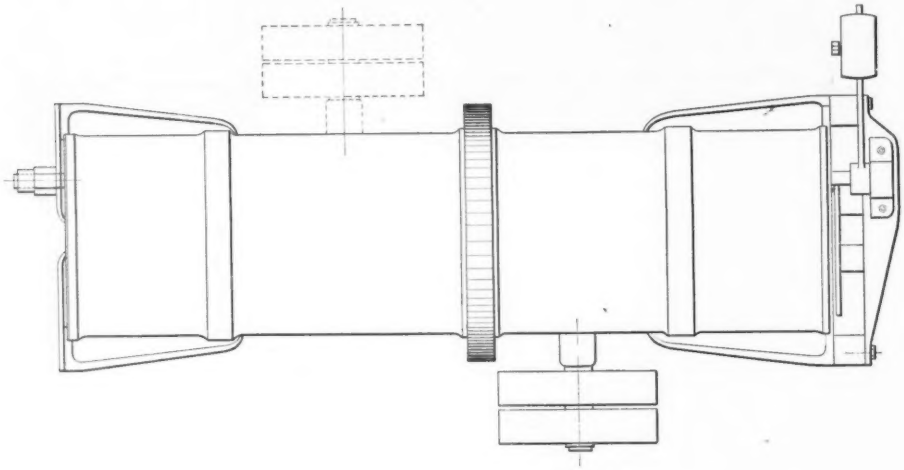


FIG. 3.—PLAN VIEW SAND MILL.

beam. This plate is so arranged that it can easily be replaced when worn out. As the sand is discharged it is mechanically screened and is delivered

Co., St. Louis, adapted for service in foundries and machine shops, is shown in the accompanying illustration. On account of the large size of the wheels

and efficient roller bearings the bridge can be easily moved, and the pendant chains are seldom required, except when the capacity is in excess of 5,000 pounds. The trolley has a steel frame and roller bearing machine tread wheels. The beams of the crane are reinforced with channels riveted to its sides The compression members are of heavy cast iron, and the tension members, steel bolts and all parts are designed to provide for a large factor of safety. They are made up to 40-foot span and 20,000 pounds capacity, and will permit hoists to be mounted transversely, horizontally, or vertically. When the hoists are to be monuted vertically a trunnion trolley is furnished.

CURTIS DOUBLE I-BEAM TRAVELING CRANE.

NEW FAN AND BLOWER PLANT.

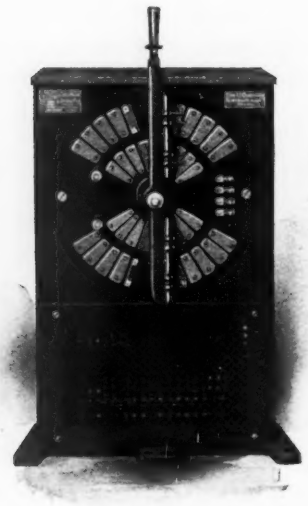
The Massachusetts Fan Co., Waltham, Mass., manufacturer of fans, blowers, heaters, etc., has purchased 4½ acres of land on Howard street, Watertown, Mass., on which are several manufacturing buildings which will be remodeled. These buildings have approximately 40,000 square feet of floor space, in which will be placed cranes and other equipment to make the plant thoroughly up-to-date. The company is building a new brick boiler and engine house, 30 x 50 feet, in which will be placed both steam and gasoline engines of 60 horsepower each. These engines will drive a 40-kilowatt generator to develop power for lighting and power purposes. Each line of shafting throughout the buildings will be driven by an individual electric motor. A 3-ton electric elevator will be installed. Orders have been placed for most of the equipment. A brick building, 45 x 75 feet, will be remodeled for drafting and office purposes. The business has been located at Waltham for five years.

A NEW LINE OF CONTROLLERS

The Electric Controller & Supply Co., Cleveland, is placing on the market a new line of controllers known as type G, which have a rating of from one to 50 horsepower. These controllers were built to meet the requirements of general crane service where the conditions are not severe enough to demand the use of the Dinkey ventilated controller. Type G-3 and G-4 controllers are built with coil resistance and type G-5 and G-6 are built with cast grid resistance. When it is desired to place controllers above or in the rear of the operator, type G controller is furnished, arranged for under lever operation. It is also furnished with spring return for operation from the floor by means of pendent ropes or chains.

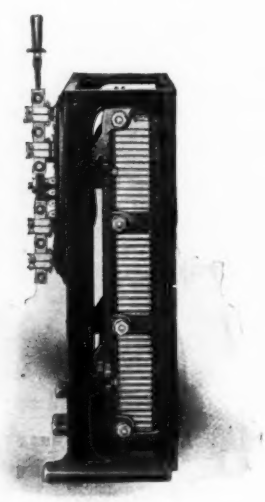
Type G controller meets the demand for a controller up to 50 horsepower arranged for operation from the floor by means of ropes. This controller is a self-contained unit, the resistance being placed in the frame, making it necessary to run only four wires between the controller and motor. Reversal is accomplished by the use of a single lever, no separate reverse switch being required. The type G controllers are self-contained, compact, and accessible. All parts are

made to jig and are interchangeable. The contact face is of heavy slate free from metallic veins. The contact segments are of copper, which are screwed



TYPE G-5 CONTROLLER, FRONT VIEW.

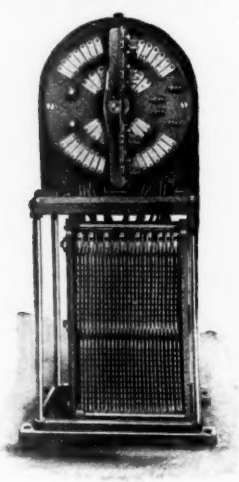
to brass lugs to which all wiring connections are made. By this construction any of the contact segments can be



TYPE G-5 CONTROLLER, SIDE VIEW, CASE REMOVED.

removed and replaced without disturbing the wiring connections. The contact arm is of soft cast iron and carries the fingers and finger holders the insulation of which is of heavy pressed valcabuston bushings. The contact fingers are of dropped forge copper of great hardness and may be removed and replaced without removing the contact arm. A powerful and effective blowout is provided in all sizes of these controllers.

The frame for types G-3 and G-5 controllers consists of a main casting in one piece provided with a cover, the removal of which affords easy access to all resistance connections. The case enclosing this frame is of perforated steel, thus allowing ample ventilation. The frame of the G-4 and G-6 controll-



TYPE G-6 CONTROLLER, FRONT VIEW, CASES REMOVED.

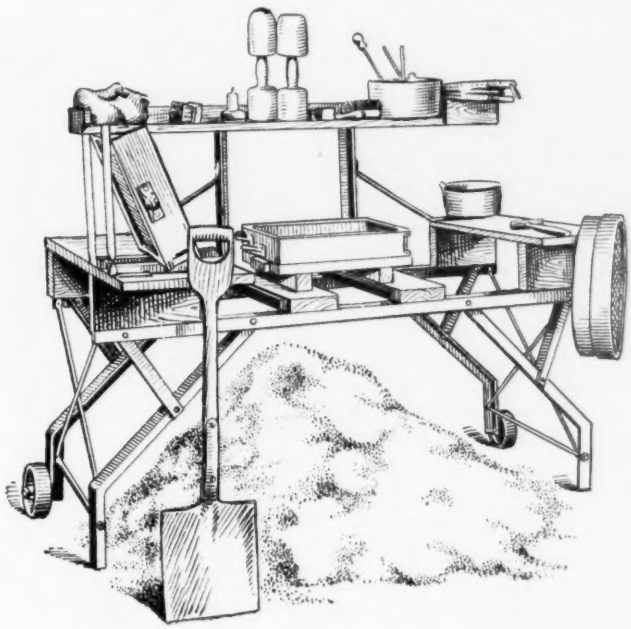
ers consists of a bottom casting which supports the resistance, and a top casting which supports the contact slate and arm. The top and bottom casting are connected by means of four steel corner posts, around which a casing of perforated steel is provided for ventilation and protection to resistance. The top casting of the G-4 and G-6 controllers supports the contact slate which is completely covered and protected by a sheet steel casing. This protects the operator from coming in contact with any live parts of the controller, and also protects the working parts of the controller from dust and dirt. Easy operation is

secured by a lever which is keyed to the arm shaft at the back of the top casting which gives a short movement of about 10 inches in either direction for both starting and reversing.

The resistance for the G-5 controller is built of cast grids in a single bank, which may easily be removed as a unit without disturbing the other parts or moving the controller. The resistance for the G-6 controller is made of two banks supported on bars attached to the frame, and may be removed in separate units without disturbing the other parts. The resistance for the G-3 and G-4 controllers is made of type E coils, which consist of a heavy asbestos tube stiffened by means of a central brass tube which serves to bring the rear terminal forward, facilitating the necessary connections. These controllers are very adaptable for service up to 500 volts. Six points of control are provided with the G-3 and G-5 controllers, and eight points of control with the G-4 and G-6 controllers.

SNAP BENCH.

The portable snap molder's bench shown in the accompanying illustration, manufactured by the Stockham Homogeneous Mixer Mfg. Co., Piqua, O., is designed to meet all the requirements of the bench molder and is so compactly arranged that more men can work on a floor than is possible with a bench of the stationary type. The main body of the bench is made of steel angles, the front legs being made of one continuous piece, with a foot turned on the bottom of each end to permit the bench to rest on the floor. The back legs are similarly made and have wheels adjusted so that the molder in picking up the front legs clear of the floor, can move the bench to any desired location on the back wheels. When the front feet are on the ground the bench is rigid. The frame work to which the boards are attached is also made of angles and riveted to the top of the legs. It is well braced, making the bench thoroughly rigid. From the



PORTABLE SNAP MOLDER'S BENCH.

front to the back of the frame there are two angles made in one piece which extend over the frame and then upward the necessary distance and then forward to receive the shelf on top. The board on the left side which extends forward and which is raised above the ramming boards, is used by the molder to hold the cope in the natural position, so that he can ream out his gates, patch up his draw plate, and blow off the loose sand without stooping over. This board has two strips running crosswise on which the cope may be set, which provides a better surface than a smooth board. Attached to this board are two steel strips against which the cope can be leaned, and which prevents it from falling from the bench. This framework can also be used as support for the cope when cored molds are being made. The board shown at the right is not as long as the one at the other end of the bench, and is provided with a round-nosed hook at one corner to receive the riddle. The shelf on top is provided for the molder's tools, such as rammers, facing bags, rapping bars, gates, parting sand pots, draw hooks, slicks, gate spoons, gate cutters, etc. These benches are made in two sizes, 52 inches and 60 inches wide, have a height of 30 inches to the top of the ramming boards and 19 inches from the top of the ramming boards to the top of the shelf. They weigh complete 140 pounds.

SHIPMENTS NOT DELAYED.

The Hill & Griffith Co., Cincinnati, manufacturer of foundry facings, supplies and equipment, announces that all orders and mail addressed to its Cincinnati office will be given prompt attention, as heretofore, and that all orders are being rapidly executed, notwithstanding the destructive fire which on Jan. 20 destroyed its plant. Plans are already well under way for the erection of a new building and arrangements have been made which will insure the prompt delivery of all foundry supplies and equipment, as in the past.

FLAT BACK MOLDER'S SHOVEL.

A molder's shovel which, it is claimed, will enter the sand easily and discharge it quickly, has been placed on the market by the Wood Shovel & Tool Co., Piqua, O., manufacturer of shovels, spades and scoops. It is

FLAT BACK MOLDER'S SHOVEL.

of a flat back design, the frog being placed on the front portion of the blade, permitting the use of the back for spreading and packing the sand evenly and smoothly. Another point of superiority claimed for the flat back by the manufacturer is the distribution of the wear across the entire back of the blade instead of down the center, insuring a longer life. The blades are free from pits and are given a mirror polish. The handles are given a high lift and the shovel is well balanced.

A NEW MALLEABLE MELTING FURNACE.

A malleable iron melting furnace which is similar in design to the standard type, but which also embodies several meritorious features, has been developed by the Buffalo Furnace Works, 229 Carolina street, Buffalo. Before the furnace was designed personal visits were made to a large number of foundries where data was secured concerning the area of hearth, grate surface, air pressure, relative height of front and rear bridge walls, size of stacks, and other important details which are so essential to the satisfactory working of a furnace. To facilitate poking and skimming, swinging brick-lined doors have been installed, which not only add materially to the apperance of the furnace, but have already proved a great convenience to the workmen.

The fire door is long and narrow, which permits of an easy distribution of coal to every part of the grate. This not only facilitates melting, but is a factor in lengthening the life of the furnace. The bung clamps are constructed of rods, are light in weight, making what may be termed a flexible form easily adjustable to the natural rise of the arch brick, instead of forcing the brick to fit the curve of a rigid casting, and which when drawn up securely has a tendency to crack or crush the brick. It is further claimed that this flexible clamp permits the roof brick to wear much thinner without replacement.

Furnaces of this type now in operation, according to their size, are producing from 15 to 45 tons in two heats per day, six days in the week. These records are given as daily performances, and the furnaces show marked economy, both in repairs and fuel consumption. The company builds the furnace complete, or will furnish working drawings.

TRADE NOTES.

The S. Obermayer Co., Cincinnati, has been appointed western sales agent of the E. H. Mumford Co., Philadelphia, for the sale of its power ramming molding machines, as well as the Rathbone multiple molding machine. This business will be directly conducted through the Chicago office of the S. Obermayer Co.

H. S. Vrooman, Chicago, dealer in fire brick, fire clay and molding sand, has established offices in the Fisher building, suite 1118 to 1119.

The Vollkommer-Reich Co., Empire building, Pittsburg, has been incorporated by Jos. Vollkommer, Theo. J. Vollkommer and William J. Reich. This company will act as consulting and contracting engineer for electric welding installations, including appliances and devices for the repairing of steel castings having cracks and blow holes.

Smyth, Swoboda & Co., 73 Warren St., New York, have completed a new plant, well equipped ror grinding and mixing "Lycopart," which is a new parting compound. Both members of this firm have had a wide experience in foundry work and have made a study of the requirements of parting compounds.

N. S. Bartlett & Co., Boston, have been appointed sole agents for the sale of the iron manufactured by the Virginia Iron, Coal & Coke Co., not only in the New England states, where they have represented this company for many years, but also in the additional territory defined as "North of and including Richmond, Va., and east of Pittsburg, and omitting what is known as the Pittsburg territory." This agency covers the sale of the iron made at the Virginia company's Crozer, Dora, Radford, Max Meadows, and Bristol furnaces, in Virginia, and the Watts furnaces in Kentucky. An office has just been opened in the Whitehall building, New York.

The Thomas W. Pangborn Company announce that on or about April 1, its general offices in New York will be removed to the new West Street building, located at West and Cedar streets.

The Partamol Co., New York, announces its removal from 605 Broadway to the Brandreth building, 415 Broadway.

TRADE PUBLICATIONS.

FOUNDRY SUPPLIES.—The J. D. Smith Foundry Supply Co., Cleveland. Catalog and price list No. 37, standard size, 6 x 9 inches, 260 pages. Describes the full line of foundry supplies and equipment manufactured and sold by this company. The completeness of the work and the facilities of this concern are reflected in the table of contents, which contains more than 500 page references. The book is profusely illustrated and is handsome typographically. Attention is directed to the company's engineering department, which makes a specialty of designing foundries complete, from the planning of the buildings and various departments to the construction and installation of the equipment. In addition to its corps of engineers an architect is constantly employed, who has had wide experience in all classes of industrial building work, and who gives special attention to the lighting, heating and ventilation of these plants. The last 17 pages of this catalog are devoted to tables, recipes, and other useful information for the foundryman.

BRUSHES, BROOMS AND FOUNDRY SUPPLIES.—The Osborn Mfg. Co., Cleveland. Complete catalog and price list, standard size, 6 x 9 inches, 199 pages. In addition to the full assortment of brushes, brooms, etc., for the general trade, numerous lines are shown which have been designed for special purposes. Those for the foundry trade include all sizes and shapes, from the core box brush to the largest wire brush for cleaning castings. This catalog also shows that the company has made many additions to its lines of foundry tools and supplies. The ladle section of the work alone covering 16 pages. The book is bound in buckram and stiff cardboard.

CRUCIBLES, THEIR CARE AND USE.—Joseph Dixon Crucible Co., Jersey City, N. J. Booklet, standard size, 6 x 9 inches, 40 pages. John A. Walker, vice president and general manager of the Joseph Dixon Co., is the author of this book, the purpose of which is to inform the user of crucibles as to their nature and characteristics and to give them suggestions as to their use, which, if followed, will add to their efficiency and greatly prolong their length of service. The causes of scalping are gone into very carefully and valuable rules for annealing are likewise given. Other subjects touched on include pin-holes and their cause, the use of tongs and their mis-use by careless melters, the proper shape of tongs, the placing of metal in crucibles, the use of different kinds of fuel, and the importance of perfect combustion. In addition to the number of valuable tables, the book contains suggestions of help in case of accidents, rules in case of fire, and a monthly wage table ranging from one month to one year at various rates. Considered as a whole, the work is very complete and will prove of great value to every user of crucibles.

AIR COOLED ELECTRIC TOOLS.—Chicago Pneumatic Tool Co. Catalog, standard size, 6 x 9 inches, 60 pages. Describes the full line of Duntley portable electric drills, grinders, and hoists manufactured by this company. The introductory note states that the demand for electric portable tools which would perform the same service and meet the same requirements as pneumatic tools has been unusually heavy, especially among concerns not wishing to incur the expense of compressor installations, but which still have a surplus of electrical power. The drills for direct current are built in three distinct types, of single motor, 2-motor, and 3-motor respectively, while those for alternating current are similar in all mechanical respects to the single motor direct current drills. In addition to the tools noted above, buffers, blowers, and hoists are likewise described.

INDUSTRIAL CARS.—The Wonham-Magor Car Works, New York. Catalog, standard size, 6 x 9 inches, 160 pages. Describes full line of hopper cars, ranging in capacities from 5 to 20 tons, tank cars, steel frame gondolas, flat cars, various kinds of dump cars, and industrial works cars for billets, castings, etc. Portable and industrial tracks are also described and tables for computing the hauling capacity of locomotives on any practical grade, and with cars of varying frictional resistance are given.

PORTABLE LIGHTS.—Wells Light Mfg. Co., New York. Booklet, 20 pages, standard size, 6 x 9 inches. Describes the portable lights manufactured by this company and several illustrations are given of their application. The Wells oil gas lamp is recommended for foundry use, owing to its compact construction. It is made in one size only, 200 candle power, the tank holding 1½ gallons of kerosene, sufficient for four hours burning without refilling.

AIR COMPRESSORS.—Ingersoll-Rand Co., 11 Broadway, New York. Catalog H-36, standard size, 6 x 9 inches, 64 pages. This publication illustrates a single line of air compressors known as "Type H." They are of the duplex type, steam driven, automatic, and are mounted upon a single base and entirely contained. All possible combinations of steam and air cylinders are provided for in sizes ranging from below 10 to above 200 horsepower. The details of these compressors are illustrated and described, their functional relations are discussed, and their practical adaptation to the special and exact conditions of economical air compression is fully set forth. Full lists of general dimensions, capacities, and other particulars are given.

RAILROAD SAND CRAFT.—C. Drucklieb, New York. Booklet, 3½ x 6 inches, 20 pages. Describes the injector sand blast apparatus manufactured by this company for cleaning steel cars, locomotive work, bridges, etc.

FILLETS.—The Cleveland Fillet Co., Cleveland. Pamphlets, 4 and 6 pages. The one describes the Crescent wood and leather fillets and gives directions for their use. The other briefly covers the lines of patternmaker's supplies carried by this company and contains a price list of white metal pattern letters and figures, and shows various styles required in pattern work.

SHAKERS.—Hanna Engineering Works, Chicago. Pamphlet, 4 pages. This describes

and illustrates the Hanna portable screen shakers for foundry use, including the swivel and stationary post shakers, as well as the tripod machines of various types.

DISC FANS.—Westinghouse Electric & Mfg. Co., Pittsburg. 8-page folder, 3½ x 6 inches. Describes the application of the Westinghouse motor to the American Blower Co. disc fan. These fans are direct-connected and vary in size from 18 to 60 inches, with a range in revolutions per minute from 900 to 300.

THERMIT RAIL JOINT.—Goldschmidt Thermit Co., New York. 8-page pamphlet. Briefly describes the operation, outfit, welding material, number of men, and the working plan of a complete equipment for making rail joints.

TRAVELING CRANES.—Whiting Foundry Equipment Co., Harvey, Ill. Standard size bulletin, 6 x 9 inches, 12 pages. Describes and illustrates electric travelers and other cranes for railroad service in repair, boiler and machine shops, foundries, power houses, coaling stations, etc. The work is profusely illustrated. The cranes cover a wide range of service and embrace electric traveling, gantry and transfer cranes, transfer tables, pillar, jib and bracket cranes.

CORE DRILLS.—Ingersoll-Rand Co., New York. Catalog, standard size, 6 x 9 inches, 62 pages. Describes the Davis Calyx Diamondless core drills. This is a prospecting drill and will produce cores from 1⅝ to 15 inches in diameter, up to 6,000 feet deep. It gives a double record, depositing the cuttings successively as they occur, and removes the core in convenient lengths. For ordinary materials a rotating tooth steel cutter is used, which has a chattering action instead of a smooth cut, and for the harder materials chilled steel shot are used as an abrading material.

FIREPROOF MATERIALS.—Wendell & MacDuffie, New York. Catalog, 4 x 9 inches, 24 pages. Fully describes the asbestos and cement fireproof materials manufactured by this company, including reinforced asbestos corrugated sheathing, asbestos building lumber and shingles. A supplement is issued with this catalog, giving the drawings and dimensions of the different size slates and describing various methods of laying.

POROUS CASTINGS.—The New Era Mfg. Co., Kalamazoo, Mich. Booklet, 24 pages, 3½ x 6¼ inches. This work is devoted a discussion of porous castings, and gives the underlying causes of this annoying phenomenon and methods for overcoming the same. The booklet will prove exceedingly valuable to all foundrymen who have experienced difficulty in the past with blown castings. A number of brass and bronze formulas are also given which should prove exceedingly valuable. Directions are also given for using Metallic Phosphoro as a flux for deoxidizing purposes, for tempering bronze, and for use in Babbitt metals.

CUPOLA LININGS.—Harbison-Walker Refractories Co., Pittsburg. Booklet, 3¼ x 6 inches, 15 pages. Contains a talk on brick for cupola linings, which is addressed to the foundry superintendent, and is intended to acquaint the shop management with the fire brick cupola linings manufactured by this company. The booklet contains many valuable suggestions regarding the laying of cupola blocks and brick, as well as mixtures of material best suited for daubing and patching. The booklet is only intended to cover brick for cupola linings, as the company has a standard catalog which covers all the lines of refractory materials it manufactures.

ENGINES.—American Blower Co., Detroit. Catalog No. 206, 7 x 8¾ inches, 60 pages. This work describes the "A B C" vertical automatic high speed, enclosed, self-oiling engines, manufactured by this company. The types described include the high-pressure, enclosed, and automatic oiling, as well as those provided with throttling governor and those which are direct connected for blower work, some of which have an outboard bearing attached for overhung wheel. The single cylinder, low pressure engines are described in the second section of this catalog, the double cylinder, high pressures engines are shown in section 3, and in section 4 are shown the single and double cylinder engines attached to dynamos, centrifugal pumps, etc.

CATALOGS WANTED.

P. Aubie, ingenieur, Ste. Metallurgiguide, Perigord Fumel, Lot et Garonne, France, desires catalogs of foundry tools and equipment, including jib and traveling cranes, trolleys, hoists, molding machines, ventilators, etc.

Walter Gerhardi, 14 Rue St-Lazare, Paris (9e), would like to receive catalogs from American manufacturers of all kinds of foundry equipment, including cranes, ladles, cupolas, etc.

OBERMAYER BULLETIN.

The January and February number of the *Obermayer Bulletin*, issued by the S. Obermayer Co., Cincinnati, in addition to its usual quota of excellent articles on foundry practice, contains a pretty sentiment in the shape of an insert, which is suitable for framing.

MILWAUKEE'S GREAT RECORD.

The product of the 42 iron, steel and heavy machinery manufacturing establishments of Milwaukee, for the year 1906, was valued at $47,501,000. The product of the 25 malleable iron and hardware manufacturing plants for the same year was valued at $6,136,430.

METALS IN FOUNDRY PRACTICE

Devoted to inquiries from Practical Foundrymen on subjects relating to the Melting and Using of Cast Iron, Malleable Iron and Steel.

The following experts answer questions in this department:

W. J. Keep, Cast Iron.

J. B. Nau, Metallurgy of Steel and Steel Castings.

Dr. Richard Moldenke, Malleable Castings.

We have also made arrangements with several others to act as special contributors. All inquiries should be addressed to the Editor of THE FOUNDRY, and they will then be forwarded to those in charge of the different subjects.

CAST IRON NOTES.

BY W. J. KEEP.

DIMENSIONS OF A CUPOLA.

Question.—Six dimensions are asked for and the questions were submitted to the Whiting Foundry Equipment Co., Harvey, Ill., Byram & Co., and Northern Engineering Co., Detroit.

Answer.—From their replies we have drawn the following conclusions:

First.—The height from the bottom door to charging door for a 36-inch cupola, will depend upon the conditions of operation, the length of the heat, cost of elevating the charges, and the saving by absorption of heat in passing through the charges.

Twelve feet is the shortest distance given. (The M. S. Co. cupolas are 15 feet.)

Second.—The height of the stack above the charging door should be such that the top of cupola will be five or six feet above the adjacent portions of the building, say 20 feet. (The M. S. Co. provides 50 feet, or the top of the cupola 75 feet above the foundry floor to prevent gases from being a nuisance to neighbors.)

Third.—The diameter of small cupolas is the same above as below the charging door. The thickness of lining is never less than 4½ inches and seldom more than nine inches. For 36 inches inside the lining the usual diameter of shell is 48 inches.

Fourth.—The distance from the bottom door to the tuyeres depends upon the class of work and the kind of fuel. The standard height with coke is 20 inches. It is greater with coke than with coal and when the iron is taken out as fast as melted the tuyeres should be 12 inches above the sand bottom. For heavy machine work it is sometimes two feet or more.

Fifth and Sixth.—The size and number of tuyeres should be such as to admit sufficient air for rapid melting. The tuyere should be wider at its inner end to give a soft blast and not cut the lining. The more nearly the tuyere is continuous the better. All of the above makers of cupolas make two rows of tuyeres, the upper row being quite small. It is better to purchase a cupola than to try to make one.

RUNNING A FOUNDRY BY GUESS.

Question.—We make mine car wheels. We purchased this plant some time ago and among our purchases was a lot of foundry pig, brand and analysis unknown. We purchased a carload of old wheels, 33 inch, and as the chill in the old wheels was too high for the wheels we manufacture, we used the foundry pig on hand to reduce the chill to ⅜ inch. This is the usual practice in making mine car wheels but we are losing a large number of wheels from shrinkage and from shot forming in our castings. We have had wheels suddenly break after being out of the pit several days. This, of course, indicates severe strain which we attribute to sulphur in the pig iron. The fracture usually shows the shot we spoke of.

What would be the ideal analysis of pig iron to mix with old wheels to give ⅜-inch chill on a 16-inch wheel, using 75 per cent old wheels and 25 per cent pig?

Answer.—Your trouble is not sulphur in your pig but that you are guessing at everything. It is probable that you cannot get an analysis of old wheels that would show you what you are using as no two may be alike; therefore it would do very little good to have an analysis of pig iron.

I would purchase a carload of No. 2 pig having about 2.25 per cent silicon, also a smaller quantity of iron with silicon over 4.00 per cent, and I would ask for an approximate analysis from the concern from which the purchase is made.

Make a mixture 75 per cent old wheels and 25 per cent of No. 2, and cast a chill piece of the same thickness as the tread of the wheel and against the same thickness of chill as you use for the wheel. Break this and if the chill is too deep use a little of the iron and with high silicon increase until you get the desired depth of chill, or if the chill is not deep enough use more wheels and less No. 2 pig. Make the chill piece each day and vary the mixture to keep the chill the same. You can cast the chill piece from the first charge of the heat and vary the mixture so as to get the proper chill before you are through with your heat.

When you are running in good shape you can use more or less of the pig that you purchased with your yard until it is gone.

Your trouble is that you have not enough silicon in your pig iron and not with too much sulphur.

This simple way is better for you than to make analyses of your materials.

PITTED CASTINGS.

Question.—The top surface of our castings are covered with a large number of small round holes some of which contain solid round particles. These often appear only after machining. We are using

10 per cent pig,	silicon	4.61, sulphur 0.045, manganese 2.75
20 per cent pig,	silicon	2.90, sulphur 0.024, manganese 2.33
70 per cent machining scrap,	silicon	2.40, sulphur 0.06, manganese 0.60

(The analysis of scrap is estimated.)

Is it advisable and is it general practice to vent the cope when the mold is vented on the bottom, with castings weighing one to 1,000 pounds? We use No. 4 North river sand. Is this porous enough not to require top venting?

Our last analysis of castings was silicon, 2.43; sulphur, 0.106; manganese, 0.70.

Answer.—The above mixture figures

Silicon	2.72	loss 0.3	=	2.42
Sulphur	0.05	gain 0.03	=	0.08
Manganese	1.16	loss 0.11	=	1.05

The high sulphur actually in your castings shows that the analysis of the irons was incorrect or much more probable that you are using coke with sulphur above 1.00 per cent.

The low manganese in your castings shows that your pig iron does not contain the abnormal amount stated or else 0.46 was lost which could only be accounted for by assuming that sulphur in the coke was much greater than 1.00.

It is customary to vent the cope of a mold as well as the drag and you certainly should do so with your conditions, suppose you use a very small quantity of commercially pure aluminum. It can be purchased in ⅜-inch wire sections and can be cut into ½-inch lengths. Use one piece for every 50 pounds of iron and it may take out the pits.

FREE FROM DUST.

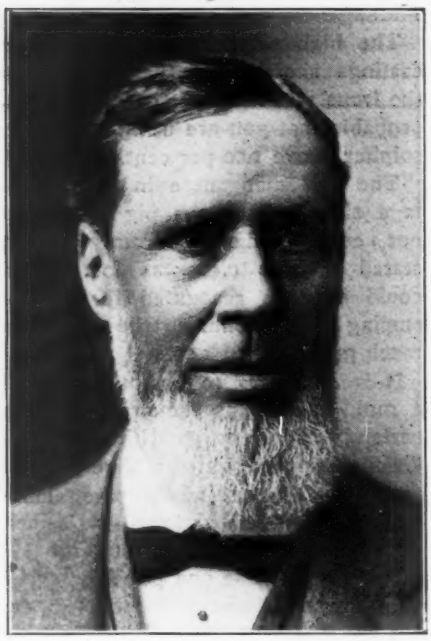
The Humphreys Manufacturing Co. has received the first consignment of a new molding sand, which has been tested in the east and found to be more free from the dust which usually mixes in with the sand. The new molding sand comes from the Atlantic coast near Cape May and it is expected that the molders will be able to have better grades of castings.—Mansfield, O., *News.*

TURNED OVER THE KEY.

Today the key and the deed for the stove foundry property was turned over to the new proprietors, Messrs. Fred Eckert and I. L. Stern.—Madison, Ind., *Democrat.*

OBITUARY.

Thomas F. Griffin, founder of the Griffin Wheel Co., died of pneumonia. Monday, Feb. 11, at the home of his daughter, Mrs. P. J. Geraghty, in Chicago, after an illness of only 36 hours. The body was conveyed to Detroit and



THOMAS F. GRIFFIN.

buried Wednesday in Mt. Elliott cemetery. Six children survive him, T. A. Griffin, president of the Griffin Wheel Co., Chicago; P. H. Griffin, Buffalo; Mrs. P. J. Cullen, Buffalo; Mrs. E. C. Walker, Walkerville, Canada; Mrs. A. W. Brewster, Washington, D. C., and Mrs. P. J. Geraghty, Chicago.

Deceased was well known throughout the country because of his prominence as a car wheel manufacturer. A history of his life is almost a history of the car wheel business in America. He was born in county Limerick, Ireland, Dec. 18, 1826. Eight years later, the family removed to the United States and located at Rochester, N. Y. In the foundry of Traver & Benedict in that city, Mr. Griffin served his apprenticeship as a molder. In 1848 upon the admission into the firm of William Kidd, a pioneer in the car wheel business, the company engaged in the manufacture of wheels under the Washburn patents, which cover the present double-plate wheel in universal use today. This dates Mr. Griffin's first connection with the car wheel business, but from that year he has been continuously identified with it. He remained in Rochester with the Kidd foundry as the firm was afterwards known, until 1873, when he removed to Detroit to take charge of the foundry of the Michigan Car Co., since absorbed by the American Car & Foundry Co. This was the first wheel plant to be started west of the Hudson river, and to Mr. Griffin belongs the credit of being the first practical wheel foundryman to locate in that territory. At that time there were only four firms engaged in the manufacture of car wheels, one plant being at Worcester, Mass., which was the old Washburn foundry; another at Jersey City; the Kidd foundry at Rochester, and the plant of Jagger, Treadwell & Perry at Albany, N. Y. Shortly after coming to Detroit, Mr. Griffin severed his connection with the Michigan Car Co. to engage in business for himself; and in 1875, he incorporated the Griffin Car Wheel Co. The original plant had a capacity of 18 wheels per day. From this small beginning, under his practical and able management, and later under that of his son, the present head of the concern, the company's output has increased to 6,000 wheels, with plants located in Boston, Detroit, St. Paul, Kansas City, Denver, Tacoma, and three in Chicago.

James Duncan, a pioneer foundryman, died at his home in Green Bay, Wis., Jan. 9, aged 81 years. He was a native of Scotland and came to America in 1851, locating in Milwaukee. In 1868 he erected a foundry at Green Bay, which he operated for many years. It is claimed that Mr. Duncan, while in Milwaukee, built for the Chicago, Milwaukee & St. Paul Railroad Co., the first locomotive built in Wisconsin. Three sons survive him.

Noah W. Gray, a prominent figure in the Lake Superior charcoal iron trade for nearly 35 years, died at Marquette, Mich., Jan. 9. Born at Romeo, Mich., Jan. 10, 1847, he was educated at Dick-

inson academy in that town and later spent a year at the University of Michigan. In 1873 Mr. Gray and William Burt built Carp furnace at Marquette. Later in turn he became connected with the Peninsular furnace at Detroit and afterward took charge of Ashland furnace at Ashland, Wis. In 1899 Mr. Gray and Charles H. Schaffer were associated in the reconstruction of the Carp furnace at Marquette, and were identified with that enterprise until the furnace was sold to the Pioneer Iron Co. The Boyne City Charcoal Iron Co., was then organized, with Mr. Schaffer as president and Mr. Gray as secretary and treasurer, the company rebuilding at Boyne City, Mich., the old St. Ignace furnace. The headquarters of the company were at Marquette and the furnace has now been active for about two years.

Robert Alexander Duncan, aged 66, one of the pioneer stove founders of Pittsburg, died recently at the home of his sister, Mrs. James H. Mitchell, in Wilkinsburg.

R. C. Faulconer, for years prominent in the foundry and machinery trades, died at New Bedford, Mass., January 18, aged 62 years. He was born in England. After several years of connection with railroads at Detroit as purchasing agent and in other capacities, he engaged in the lumber business at Alpena, Mich. He was one of the organizers of the Leland & Faulconer Mfg. Co., Detroit, being associated with H. M. Leland in bringing that enterprise to a very successful footing. Ill health led to Mr. Faulconer's retirement from the company in 1901.

P. Henry Herbert, Worcester, Mass., formerly one of the owners of the Globe foundry of that city, died January 23, aged 53 years. He was a native of St. John, N. B., and learned the molder's trade at Worcester.

A. R. Ludlow, president of the Springfield Malleable Iron Co. Springfield, O., died January 2, aged 81 years. He had been engaged in the foundry business since 1863 and started the first gray iron foundry of importance in Springfield. His connection with the Springfield Malleable Iron Co. dated from 1880.

Henry Clark Sargeant, of the Ingersoll-Sergeant Co., now an integral part of the Ingersoll-Rand Co., died from paralysis at his home in Westfield, N. J., Jan. 30, at the age of 72. He was widely known as an inventor of successful mechanical appliances, especially in the line of rock drills, air compressors, and general mining machinery, and for his ability in developing the details of their successful manufacture by the company which bears his name.

PERSONAL.

O. A. Kresse, formerly connected with the J. A. & P. E. Dutcher Co., Milwaukee, has taken charge of the steel making department of the Prescott Co.'s new steel foundry at Menominee, Mich., which will be placed in operation about April 1.

J. B. MacMeekin, formerly with Jas. Gurney & Co., Boston, Mass., has been appointed foreman of the foundry of the S. C. Tatum Co., Cincinnati, to fill the position made vacant by the resignation of E. W. Cadwell.

S. D. Porter, general manager of the Acme Harvesting Machine Co., Peoria, Ill., has resigned, in order to look after his own business interests in Ohio.

A. F. Gartz, for many years treasurer of the Crane Co., Chicago, has been elected president of the Central Foundry Co., New York, to succeed Alfred Fowle Jr., recently resigned.

Robert S. Bosworth, formerly connected with Rogers, Brown & Co., has purchased an interest in Hugh W. Adams & Son, Inc., pig iron commission merchants, New York, and is now secretary of the company.

Philip C. Moore, formerly with the Washington Coal & Coke Co., at Dawson, Pa., has been made general sales agent of the Pickands-Magee Coke Co., Frick building, Pittsburg.

Francis F. Coleman has joined the Lidgerwood Mfg. Co., 96 Liberty street, New York, as publicity manager. He was formerly with the Westinghouse and Allis-Chalmers compan-

ies, and recently with the Traylor Engineering Co.

C. W. Comstock, who has been purchasing agent for the Wellman-Seaver-Morgan Co., resigned Jan. 1 and has been appointed district sales manager for the Chandler & Taylor Co., of Indianapolis, with offices in the Caxton building, Cleveland.

Westley R. Mason has resigned as district manager of the American Car & Foundry Co., Detroit, and accepted the position of second vice president and general manager of the Dominion Car & Foundry Co., Montreal, Que.

J. C. Miller has resumed his former positon as sales agent of the Columbus Iron & Steel Co., Columbus, O., manufacturer of Bessemer, basic, malleable and foundry pig iron.

John C. Reed, manager of the Standard Works of the Standard Sanitary Mfg. Co., Pittsburg, was agreeably surprised at the Fort Pitt hotel on the evening of Jan. 16, by a banquet given in his honor by the employes of this plant, who also presented him with a handsome loving cup.

S. A. Carson, formerly connected with McKeefrey & Co., Leetonia, O., and who was at one time in the employ of the H. C. Frick Coke Co., has taken charge of the coke department of the Iron City Coal & Coke Co., Pittsburg.

Charles Lyons and Joseph Hammer, who have been in the service of the Buckeye Steel Castings Co., Columbus, O., as purchasing agent and yard foreman, respectively, have taken positions with the Bucyrus Steel Casting Co., Bucyrus, O., the former as general manager and the latter as superintendent.

Pierce D. Schenck, who has been vice president of the Dayton Malleable Iron Co., Dayton, O., for the past four years, has been elected president to fill the vacancy caused by the death of W. B. Earnshaw, Oct. 31.

Fred G. Roller, formerly with the Penn Steel Casting Co., Chester, Pa., and the Bateman Mfg. Co., Grenloch, N. J., has accepted the position of superintendent of the Belmont Iron Works, Philadelphia.

Fred J. Miller has tendered his resignation as editor of *The American Machinist*, and is succeeded by F. A. Halsey. Mr. Miller has been a member of the editorial staff for 20 years and has been editor for a number of years. Mr. Halsey has been a member of the staff 12 years.

J. B. Halloway, who has been connected for some time with the Philadelphia branch of Rogers, Brown & Co., has taken the agency in that city of N. S. Bartlett & Co., Boston, and will make a specialty of Virginia and Pennsylvania irons.

ANNEALING MALLEABLE CASTINGS.

On the general subject of annealing, Dr. Richard Moldenke, writing in *Cassier's Magazine*, on the "Production of Malleable Castings," says:

The question of annealing is an interesting one. A short heating to the proper temperature on the part of a hard gray iron casting softens it sufficiently to allow machining. This is the conversion of the comparatively small amount of combined carbon present over the normal figure to the "temper" carbon of the malleable casting. This "temper" carbon, so named by the late Professor Ledebur, from "temperguss," the German for malleable cast iron, is an uncrystallized graphite which has the peculiar property of recombining at a temperature below the melting point. Thus heating an annealed casting red hot and plunging into water usually makes its structure white again, but this structure is now that of a high carbon steel, rather than a white iron. While, therefore, this short annealing of a hard gray casting does it good, the continued heat of the malleable casting process applied to the same casting would ruin it by allowing the penetration of oxygen, burning, or at least oxidizing, each crystal of iron, separated as they are, by the flakes of graphite in the gray casting. Hence the necessity of keeping out graphite from the hard casting intended for the malleable anneal.

The annealing process is further interesting from the fact that only the con-

version of the carbon is a necessity to make malleable cast iron, and not the removal of the carbon from the skin, which is the understanding generally. While this removal of the carbon in the skin does take place in the ordinary process where an iron oxide is used for packing the castings into the annealing pots, yet by doing this in sand or in fire clay the same results are obtained, the only difference being a smaller tensile strength. As the flakes dropping from the annealing pots can be crushed and used for the packing medium there is no necessity to resort to annealing in sand in order to save money, especially as a weaker casting is the result. Experiments made with numerous test bars, the skin of which had been removed from half their length, showed that the black interior of a malleable casting having the original amount of carbon intact, though converted from the combined state, is but 2,000 to 3,000 pounds per square inch less in tensile strength than the bar with the skin left on.

The founder has to deal with many molding problems also, for the contraction of the hard casting is twice that of a soft gray one. The annealing process restores half of this shortening up in length, breadth and thickness, but the consequence is that very large castings are difficult, if not impossible, to make without concealed cracks occurring where least wanted. Furthermore, the internal shrinkage of the metal is a serious question, taking place at abrupt changes of section and sharp angles. Hence the use of chills in the molds to overcome this difficulty. On the whole, therefore, the malleable casting is seldom over 175 pounds in weight, or 3 feet in length, or ¾ inch in thickness. The great majority of even the heavier castings do not exceed 10 pounds.

THEORY OF SEA COAL MIXTURE

Question:—What is the actual effect of sea coal on the action of heat that is produced by the molten metal? We all know that in making a mold you add the coal dust to prevent the walls of the mold from burning on. Therefore, what is the philosophy of this coal dust? It will form a gas against the walls of the mold and therefore allow the hydrogen gas to escape more freely through the walls, but what takes place between the metal and the face of the mold? Does the hydrogen gas take up the carbon that the coal will produce and form a film against the sand? Please give me the theory and philosophy of the sea coal mixture that has been used in foundries for the last few centuries.

Answer:—Sea coal facing is mixed with the sand in proportions depending on the weight, size and thickness of the casting to be made. The object of sea coal facing is to so mix it with the sand that when the molten metal comes in contact with the mold it will burn out the sand nearest the metal, thereby opening the mold and allowing the gases and air which come down with the iron to escape by burning the sea coal away. The sea coal when mixed with the sand leaves it in a porous condition, thereby permitting the gases to escape. Another reason for mixing the sea coal with the sand is to prevent the latter from fusing. If there were no sea coal facing in the sand, it would have a tendency to fuse into a hard, solid mass. This experiment could be made by taking a quantity of sand and putting it in a fire of sufficient heat to fuse it. The same quantity of sand mixed with sea coal will require at least three times as long to fuse and a much greater amount of heat.

Answer:—If a high grade gas coal is used in the manufacture of facing, there is no difficulty regarding the escape of the air, as the sea coal is simply burned and provides a sufficient vent. If the proper coal is not used, regardless of the venting, the air will naturally look for an opening or outlet, and will come up through the casting and will form blowholes or tubes. This is often the case and is plainly indicated when too much sea coal is used, as the sides of the casting show arrow marks where the gas has escaped. In considering this matter some time ago with a prominent authority, the latter said that he believed that the sea coal gas forms a cushion and is the result of the formation of hydrocarbon.

MANUFACTURING COST.*

By R. H. Probert, M. E.

The question of ascertaining the cost of production is daily receiving more and more attention from the manufacturers of various lines and the absolute importance of having at least an approximate idea of what their goods cost them to produce is becoming more and more apparent. At first glance, it would seem an easy matter to secure this data, but only those who have tried to ascertain costs in a factory of moderate or large size can fully appreciate the endless difficulties to be overcome. Many systems which work out beautifully on paper are found to be either entirely impracticable or at least subject to great modification when put into actual use. The manufacturer who starts to install a cost system, even a simple one, usually finds that he has the spirited opposition of his foremen and operatives, and this is no small thing to overcome.

In making such an installation, the first things to be considered are: (1) How close an approximation is necessary. (2) What the expense will be in clerical work, etc., to obtain it. That absolute costs can be ascertained is undoubtedly a fact, but the expense involved in obtaining such accurate information is liable to be greater than the information is worth. We are all in the business to make money, and expenditure without return is, of course, unwise, and may not improve the appearance of our balance sheet at the end of the year. In many factories where obtaining an absolute cost would involve a heavy expenditure for clerks, etc., a close approximation which may be equally valuable can be obtained for much less money. The problem is to secure results which are sufficiently accurate for all practical purposes at a minimum expenditure. In using the words "close approximation," please do not infer that I mean guess work. Intelligent estimates based upon actual experience and factory conditions will work out with surprising accuracy.

There are six chief elements entering into the cost of manufacture. (1) productive labor, (2) non-productive labor, (3) raw material, (4) waste or scrap, (5) supply and repair to producing departments, (6) fixed or overhead expense. The above chief elements and their subdivisions cover every expense that can possibly accrue to the cost of manufacture.

In a short paper, it is impossible to go into minute details, but I will take up the six chief elements one by one, touching upon such points as I consider of most importance.

Productive Labor.

Theoretically ascertaining the cost of productive labor accurately is one of the easiest problems dealt with in cost keeping. Practically it is one of the most difficult. In a factory employing only five or ten men working under a capable foreman, the amount of labor chargeable to a certain finished product can be easily ascertained, but multiply the five or ten producers into 500 or 1,000, working in various departments and under foremen of varying capacity, and the task of keeping accurate records of the producing labor becomes one of magnitude. There are various mechanical aids to assist us in this work, time clocks and recorders of several kinds. All of these have their use and help towards accuracy. but all the time clocks in the world will not keep track of the time of the producers unless we have the hearty and intelligent co-operation of our superintendents, foremen and time keepers.

Conditions vary so much in different factories that it is impossible to offer any definite directions as to the methods to be pursued in ascertaining the cost of productive labor. Where the character of the product will permit it, job tickets may be issued to advantage, whereon each workman, his time keeper or foreman enters on a card or slip the amount of time de-

*Abstract of paper read before the Ohio Society of Mechanical, Electrical and Steam Engineers at the Akron meeting, Nov. 17, 1906.

voted to each particular job, these cards or slips being turned in daily to the cost department and the proper charges made by it on appropriate forms. Such methods would be entirely out of the question for a factory having a continuous production, and other methods would have to be devised.

I believe that a thorough knowledge of the details of the particular branch of manufacture is absolutely necessary to intelligently install a system for the accurate keeping track of productive labor. The manufacturing conditions, the character of the work and the personnel of the operatives, must all be taken into consideration.

For instance, what would work out perfectly in a factory where the operatives were skilled, intelligent, English speaking men, would fail signally in a factory where the operatives were uneducated foreigners. Whatever be your system, let the results be as accurate as possible, for upon the accuracy of your records of the cost of productive labor, hinges the accuracy of your entire cash system.

Non-Productive Labor.

Under this head should be charged all factory employes who are not actual producers. Excepting the superintendent and other factory employes, such as the stock keeper, night watchman, gatekeeper, etc., the non-producers can usually be charged direct to department costs, and it should always be borne in mind that a direct charge should always be made if possible in preference to a pro-rata charge. This rule will greatly increase the accuracy of your costs.

Raw Material.

All material entering into the construction of the product we sell should be classed as raw material, even though it reaches us in a partly or wholly finished state. For instance, if one of us is a machine builder, and another a bolt manufacturer, the finished product of the latter would be the raw material of the former. Keeping an accurate account of the raw material entering into our product is a comparatively simple matter, but, in the case of productive labor, a system that would be perfect for one factory, would not work out in another.

An ideal method where the character of the material used will permit, is to have all material received by a stock keeper and disbursed by him upon department or job requisitions. He keeps also an accurate record in a suitable ruled stock book and makes periodical reports to the cost department. In a continuously producing plant, it is frequently possible to keep an accurate stock of raw material in the general offices, the clerk keeping the stock book never even seeing the raw material itself.

Waste or Scrap.

If a complete stock room system is in operation, the cost of this item may be ascertained through the stock records. In some factories, a simple system of scrap reports may be installed which will answer the purpose. In any event, the keeping track of scrap and waste is worth the very serious consideration of the manufacturer, not only from the cost standpoint, but also with a view of reducing the scrappage. Many a factory could show a satisfactory balance sheet at the end of the year if the management would consider the question of scrap of more importance. It is said that when Armour & Co. get through with a hog, every part of him has been turned into money. The Standard Oil Co. are not very far behind in the absolute utilization of petroleum products.

Raw Material Costs Money.

Work on it costs more money, and if it fails to reach the market as a part of our finished product, there is a dead and sometimes entirely unnecessary loss. Look at your scrap pile, gentlemen, and look closely. See who is responsible for it. Build up a system of comparative records and you will be surprised at the results.

Supply and Repair to Producing Departments.

Under this heading should be charged all supply and repair items

which can be charged direct to the various departments. Perishable tools, waste oils, incandescent globes, machine cutters, etc. This account is kept separate from the general supply and repair account for the reasons before mentioned, that a direct charge to a department is a more accurate than any pro-rata charge can be.

Fixed or Overhead Expense.

I have placed this last in my list of chief cost elements, but it is far from being least. This is the cost item which is subject to more guess work on the part of otherwise intelligent manufacturers than all the other elements put together.

Broadly, the fixed or overhead expense account should be charged with every item of expense which cannot be charged direct to a producing department. Such a list might include some items which the manufacturer is in position to charge direct to a department, and other items may have been omitted which are a part of the general fixed expense of other manufacturers. Again, I say "Charge direct" if you can, but remember that all expense items must appear either as a direct or pro-rata charge.

How to Ascertain Our Cost.

Having arrived at the cost of the six elements above mentioned how shall we ascertain the cost of our finished product? It is obvious that the adding together of items 1, 3, 4 and 5, with either a direct or pro-rated charge of item 2 (non productive labor) will give us a part of our cost. Item 6 is, however, yet to be considered. How shall we take care of our fixed or overhead expense, and how shall we carry a proper proportion of it into our cost figures.

You would be surprised at the small importance many manufacturers attach to their fixed expenses as related to their cost estimates. It is far from uncommon for them to make simply a guess and let it go at that. One man who has guessed tells a friend that his fixed expenses amounts to 20 per cent. His friend has been so busy that he has not had time to even guess, so he takes his friend's guess as authority and considering that he runs his own business as cheaply as the other fellow, forever afterwards, his fixed expense is 20 per cent. He may strike a period of low prices on his product, and wonder why his balance sheet at the end of the year shows a loss instead of a gain, as the product was certainly sold at a profit over his "cost."

If you should suggest to him that his added percentage for fixed expenses should be 120 per cent instead of 20 per cent, he would probably say you had paresis. Even should the percentage arrived at be more than a guess, the method of arriving at it may be wrong. While opinions differ largely as to the correct method of figuring the proper proportion of fixed expense to be added to the cost, it is generally agreed that the fixed expenses should be figured against the cost element which fluctuates the least and this is productive labor.

As stated earlier in this paper, the producer is practically the sole money maker for the manufacturer. This being the case, let us use him as a basis for pro-rating our fixed expense. A simple illustration will show why this method is preferable.

Suppose we have a labor cost of $5.00
A material cost of..... 5.00

Total $10.00

We find our percentage of fixed expense figured against cost of material and labor to be 25 per cent. We therefore add 25 per cent to our $10.00 making our cost $12.50. Now suppose we substitute for our material charge $50.00 instead of $5.00, our labor charge remaining the same, then our material and labor will be.....$55.00
and our fixed expense.....13.75

making a cost of 68.75

The labor charge is the same in both instances, but in the one case we have added $2.50 for fixed expenses, and in the other $13.75.

Had we taken our productive labor

as a basis, while our percentage would have been larger, the amount we figured it upon would have been smaller, and the addition would have been the same in each instance. Our formula for our cost figures will therefore be as follows:

Add the cost of non-productive labor, waste or scrap, department supply and repair and any other direct charges, together.

Add to this the raw material, and to this total add the cost of productive labor, plus a percentage to cover fixed or overhead expense for a suitable period against the total cost of productive labor for the same period.

The well known man-hour method of pro-rating the overhead expense also has its advocates and in some instances, it will give more satisfactory results than the percentage method.

Be sure you include all proper items in your overhead expenses and watch the scrap pile for waste and spoilt material also waste material that may have been ordered wrong.

AUTOGENOUS WELDING OF STEEL.

The Worcester Pressed Steel Co., of Worcester, Mass., has installed a plant for doing autogenous welding of steel by the Epurite process. It is the second plant of the kind in the United States, the other one being at the works of the Fore River Ship Building Co., Quincy, Mass. The weld is made with a blow pipe, the gases used being oxygen and acetylene. The flame is very small, with a temperature of 6,300 degrees Fahr. The company has several ordinary employes now using this method, it not being necessary to have an expert. The flame is extremely bright and the workman is obliged to wear goggles with colored lenses to protect his eyes. Each workman has his own blow pipe, with a pressure gage and reducing valve, the pressure depending on the thickness of the weld. The company has erected a small building a short distance from the main shop, which is equipped with apparatus for generating oxygen and acetylene, a partition separating the two generators.

The oxygen is generated from epurite, a powder which contains oxygen in a form susceptible of easy liberation on contact with water, the oxygen given off being chemically pure. The welding process is named from this powder. The oxygen generator is charged with water and epurite. A solution of sulphate of iron is allowed to flow into the generator to act as a catalytic agent for the generation of oxygen. The liberated oxygen goes through a pipe underground into a gasometer in the main building and is pumped from thence into a tank under 150 pounds pressure. A pipe leading from this tank runs the entire length of a bench where the outlet pipes for the operators are located.

The acetylene apparatus is arranged to furnish the gas at two and one-half pounds pressure, the pressure of 150 pounds being intended to counteract the possible back burning of the mixture before reaching the burner. No danger exists to the operator from an explosion, and in addition to keeping the gases separate until reaching the point of combustion, the pipe is provided with wire gauze to prevent back firing. In lighting the blow pipe the acetylene is first turned full on, and regulated to about one-half atmosphere. Then the oxygen is turned on, after the acetylene is lighted. The oxygen flow is controlled so there is only one inner cone in the flame. The flame is then neutral and ready for use. By this process iron, steel, copper, brass, cast iron and other metals can be effectively welded. To bring about the proper conditions for autogenous welding of two metals, it is necessary to bring them to their melting point without oxydizing or carbonating. The hydrogen and carbon dioxide generated in the oxy-acetylene flame form a reducing atmosphere and permit the metal to be autogenously welded.

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Trade Outlook Recent developments in the pig iron market are indicative of slightly lower values. The recession in prices during the last month can be attributed to the refusal of large consuming interests to cover their last half requirements, and the outcome of spot iron has also been much heavier than was anticipated, in view of the persistent reports of barren furnace yards. Southern No. 2, for shipment after July 1, has sold at $18 Birmingham, and Ohio river furnaces have asked as high as $20 for malleable Bessemer for the last six months. For shipment during April, May and June, Bessemer and basic are selling at $22.85 and $22 Pittsburg, respectively, and No. 2 foundry on a basis of $23.50 in the Mahoning and Shenango valleys, which likewise fairly represents tidewater prices for this grade. Lake Superior charcoal is held at $27.50 Chicago, for prompt shipment with concessions ranging from $1.00 to $1.50 for the last half. The leading southern trunk lines by their decision to postpone until March 3, the enforcement of higher tariffs, on pig iron, frankly admit the unfairness of the advance. According to the traffic managers this respite was granted in view of the extraordinary and unprecedented conditions in transportation and car supply, which affected the movement from furnaces of iron sold on the old basis before the notice of the advance was given. Gray iron foundries generally are operating at their capacity and continue to experience considerable difficulty in securing an adequate iron supply. Steel foundries in both the east and west have orders before them which will insure their operations in full during the next six months and few of the malleable plants are in position to ship in less than 90 days. The scrap market, notwithstanding the mild weather which has been prevailing, and which is favorable to a heavy outcome from the country districts and from railroad yards, is being firmly maintained, although a general decline

in values is anticipated within the next 30 days.

Reign of the Chemist. Of the many difficulties attending foundry operations during periods of high pressin the iron trade, none portends more dire results than a failure of the regular iron supply. The substitution of a known and tried brand in the mixture with one that has been hastily selected to tide over an emergency, in plants not enjoying the services of a chemist, frequently raises the percentage of loss to an abnormally high point, although the silicon and sulphur content may not have differed materially from that of the grade customarily used. The variations of the other elements would immediately be detected by analysis and the mixture readjusted to meet the changed conditions, thus obviating heavy losses, but operations not sufficiently large to warrant laboratory installation are in large measure dependent upon analyses furnished by the furnaces. With the exercise of due care, when the phosphorus and manganese are known, many difficulties can be overcome by the admixture of the proper grade of scrap, or by increasing or decreasing the proportions of various brands to meet the specifications of the sections to be cast, in accordance with approved methods. In nearly all brands of iron, regardless of the grade phosphorus and manganese are fixed within narrow limits, and a fair knowledge of these distinctive features of the numerous brands that analyze closely to the one regularly used will prove a valuable guide to the foundryman in making a selection to meet his immediate needs. When the charges are made up by analysis a wider latitude in the purchase of iron is allowed, and great savings can frequently be effected. Through his ability to adapt materials to meet changed conditions, the chemist's present value is necessarily accentuated, although he is always a potent factor in overcoming many of the difficulties besetting foundry practice. The many brands of foundry iron now on the market can readily be arranged in classes best suited for certain lines of work, and a careful investigation will show that the melter is not confined within as narrow limits as generally believed. A closer grading of scrap will also prove valuable to the foundry without a laboratory as long as the pig iron supply is uncertain, and the proportion of old material in the mixture can be greatly increased if well selected, provided sufficient leeway is permitted in the castings to be made.

Technical Foundry Education. In a recent address on technical foundry education, H. E. Field directed attention to the archaic methods of foundry practice taught by a few of the engineering schools which have already installed and equipped small foundries. He ventured the opinion that the knowledge acquired by the students from one of these courses could be absorbed in any foundry within a week. The antiquated methods referred to include hand molding, without reference to modern machine operations, a careful study of the use of hand ladles instead of a knowledge of the employment of cranes and trolleys for pouring castings, and the extravagance of the cupola practice in these schools he said would bankrupt a foundry on a commercial basis. The advanced course suggested, which would specialize in foundry practice and would encompass all lines of work allied with this industry, could be profitably adopted by some technical schools now seeking new fields of endeavor.

Record Pig Iron Production. Statistics collected by the American Iron & Steel Association place the total pig iron production of the United States during 1906 at 25,307,191 tons, as compared with 22,992,380 tons the previous year, and 16,497,033 tons

in 1904. The classified production during the last two years follows:

	—1905—		—1906—	
	Tons.	Pr.Ct.	Tons.	Pr.Ct.
Bessemer	12,407,116	54.0	13,840,518	54.7
Fdry & Forge	5,837,174	25.4	5,714,492	22.6
Basic	4,105,179	17.9	5,018,674	19.8
Charcoal Iron	352,928	1.5	433,007	1.7
Spiegel & Ferro	289,983	1.2	300,500	1.2
Total	22,992,380	100.0	25,307,191	100.0

The decrease in the production of foundry and forge iron which amounted to 122,682 tons, is undoubtedly due to the rapid replacement of many cast iron sections with steel, although the gray iron foundries did not suffer from a dearth of orders during the year. Basic, however, showed an increase of 913,495 tons, which in a measure reflects the growing use of this grade in steel foundries, which are showing a decided preferment for the basic over the acid process. In this connection it is interesting to refer to the production of low phosphorus iron, which reached the total of 228,769 tons against 186,907 tons in 1905. Notwithstanding this increased output, the supply was inadequate to the demand and seaboard steel casting plants remelted large lots of this grade of foreign iron. While the consumption of malleable Bessemer is rapidly increasing, no figures are available indicating the growth of the malleable industry. Bessemer iron, in which malleable Bessemer and low phosphorus are included, represented 54.7 per cent of the year's total and showed an increase over the previous year of 1,433,402 tons, or 11.5 per cent. Canada's output in 1906 aggregated 541,957 tons, against 468,003 tons in 1905, an increase of over 15 per cent.

Foundry Supply Association. A growth of nearly 50 per cent in membership is the enviable record made by the Foundry Supply Association during the last 30 days. This foreshadows a great exposition of foundry and pattern shop tools, equipment and supplies in Philadelphia during the convention of the American Foundrymen's Association, and should insure the attendance of every progressive foundryman. The membership of the A. F. A. is rapidly moving upward and its most ardent supporters hope for an enrolment of 1,000 names at the close of the May meeting.

BRITISH NOTES.

Birmingham, England, has a lively sense of its indebtedness to the Tangyes, the well known founders and engineers, and the recent death of Sir Richard Tangye has suggested to many local admirers the advisability of erecting a permanent memorial in his honor, and of associating with him George Tangye, the surviving brother. The matter has been taken up and at a recent meeting presided over by the Lord Mayor of Birmingham, it was agreed to erect this memorial, which is to take the form of a mural tablet in the Art Gallery. Any surplus remaining after the cost of this has been defrayed, may be applied to some other purpose such as the establishment of an educational scholarship. The Lord Mayor paid a high tribute to the two brothers, whose enormous engineering establishment has achieved world-wide fame. They came to Birmingham many years ago at an early age, poor, but endowed with character and a desire for hard work. They commenced their career in a very humble manner and from this small beginning they built up a great business employing 2,000 hands.

The "S" department of Tangye's Limited held its annual dinner, Jan. 19, at the Exchange restaurant, Birmingham, when about eighty sat down, under the presidency of J. Robson, with T. H. Field in the vice-chair.

Effect of Strains in Cold-Worked Iron.—Strains in cold-worked iron or steel may be detrimental. A piece of straight, cold-drawn shafting, if machined, as for instance in key seating or in turning, is very liable to be not straight after the machining, as cutting away a part of the strained metal removes part of the stresses, and those remaining cause the resultant effect to be different from what it was, and the new adjustment necessary is found in a new shape of the piece.—*Journal of Franklin Institute.*

ASSOCIATIONS AND SOCIETIES

A meeting of the Birmingham branch of the British Foundrymen's Association was held on Saturday evening, Jan. 19, at the Technical School, Suffolk street, Birmingham, under the presidency of R. Buchanan. There was a good attendance to hear the paper read by George Hailstone on "The Characteristics of Foundry Iron." The paper was illustrated by a series of micrographs, showing the elements in their various proportions in large, small and medium castings, made from different qualities of iron.

The chairman introduced Mr. Hailstone as an old pupil, and assistant at Technical School, who for the last few years had been engaged in large Birmingham works making a series of tests with cast iron and other metals, the results of which were given in his paper which is presented in full, elsewhere in this number.

Mr. Hiorns said the paper admirably illustrated the value of the association in facilitating the spreading of such information. He added that young men of today have enormous advantages compared with the older men to whom the greatest credit is due for having done so much with so few advantages, and the paper showed they had much to learn, that the foundry trade was advancing, and that they must keep up-to-date if they were not to be left. He was proud of Mr. Hailstone as an old associate and student. The lecturer's views entirely agreed with the results of his (Mr. Hiorns) experiment. The paper showed that while a thing might be good there was a limit to its goodness, and that one material would not do for everything. When a casting was being formed on the curve, they saw at a glance the enormous variation of silicon, and how very unreliable a fracture was for sampling purposes. A number of samples proved that taking iron from No. 1 to No. 6, the percentages became larger. According to the old ideas they would have expected it to become less. The percentage of graphite and silicon seemed to be as big in No. 4 as in No. 1, which brought out very clearly a discovery he made with plates some time ago, that if cast iron were allowed to cool very slowly the graphite and silicon slipped out. He asked whether scrap iron could be used in greater proportion for heavy castings than for light ones.

Replying, Mr. Hailstone said that light castings cool quicker and the graphite does not have long to separate. With heavy castings which take longer to cool, the graphite has more time to escape, and therefore a lower total of carbon is secured.

Mr. Hiorns, referring to purchased scrap, said that if they had a load of scrap from outside, it might not be all of the same quality. He asked whether it was the custom to melt up a load of scrap and then take a sample, or was the sample taken from one small article.

Mr. Buchanan, replying to this question, said that from 300 tons of light scrap he was in the habit of taking 22 pieces from different parts of the heap and equal parts of waste were drilled from these samples.

Mr. Hiorns, continuing, said they could not depend upon fractures for their experiments. It was absolutely necesary to have analyses. Mention was made by Mr. Hailstone of the special alloys that are being made for cast iron. He imagined that some of these would be very costly.

Mr. Barker (Rugby) said he knew of one sample at £16 a ton made by a Liverpool firm, and of a second sample marked S. A. M. at about the same price.

Mr. Hiorns concluded with a reference to motor car castings in which he thought the percentage of phosphorus and sulphur was very high. This seemed to him to be very dangerous, and probably accounted for many accidents. When he heard of a motor car failing, he was inclined to blame the iron founder.

Mr. F. J. Cook, agreed that phosphorus was too high in the composition of motor car cylinders. Much, he was aware, depended on the class of engine, but in the case of some engines it was a common occurrence on a run of fifty miles for the cylinder to become red hot. A phosphorus percentage of 1½ per cent was too much in these cases. Mr. Hailstone declared that the percentage was 0.9. Mr. Cook considered that even that proportion was not good and expected the silicon to be much lower.

Mr. Barker explained that they must have a high phosphorus percentage to "form" the iron, as the cylinders are so thin in their sections, that it was a question of design, no two makes of cylinders being made alike.

Mr. Hailstone, replying to Mr. Mason, said that an increase of one per cent in manganese increased the shrinkage in iron by 26 per cent. Mr. Foster (Darlaston) mentioned that he had pointed out to the Iron and Steel Institute that silicon would not have the effect on the fracturing properties of iron that was commonly supposed, if they were careful to have a good separation of carbon, but added that sulphur had the greatest influence on fracture. It was essential to know exactly each individual element to secure economical and perfect castings. The great difference between the hot and cold blast iron was that in the cold blast iron they had less separation of carbons.

Mr. Barker, considering the question of drilling for samples, said he had found it a serious operation on account of the sand in the pig. He always depended upon fracture as the cleanest method. He considered it best to take one pig out of every five tons, fracture it across the middle, and drill into the middle of the fracture. As to scrap he suggested the use of "home" stuff, the composition of which was known. No outside scrap should be used, except to cheapen production of the cheaper grades of castings. For some years he kept it out of his works entirely. With regard to remelting, the proper way to get good results is to secure a casting of a similar size to the pig iron. The difference between hot and cold blasts he thought was not so much a question of carbon as of temperature, as the temperature at which the metal was poured had a great affect.

F. J. Cook, comparing the methods of sampling used by Mr. Barker and by Mr. Hailstone, expressed a decided preference for Mr. Hailstone's system. He had the pigs well scrubbed, and when commencing operations started the hole with a drill a shade larger than the one used to complete the operation.

Mr. Hailstone replying to the discussion said that only a small proportion of alloys were used. As to motor car cylinders, if the percentage of phosphorus were not sufficiently high, the cylinder parts would go into holes. As to the relation of silicon and fracture he found that a very small quantity of sulphur neutralized a much larger quantity of silicon. Graphite also entered into considera tion. Regarding the testing of pig iron he had always found his method satisfactory, but he always cleaned the back, top and bottom of the pig before starting. As an alternative to using outside scrap he suggested the use of a lower grade of pig iron.

Philadelphia Foundrymen's Association.

At the monthly meeting of the Philadelphia Foundrymen's Association, which was held at the Manufacturers' Club on the evening of Feb. 6, a communication was read from the New England Foundrymen's Association enclosing a protest to the Interstate Commerce Commission against

the recent proposed advance by the railroads of 25 cents a ton on southern pig iron after Feb. 1, and inviting the co-operation of the Philadelphians in the movement. After some discussion, although the date for putting the advance has been postponed, it was agreed to join in the protest.

The committee appointed to arrange for the entertainment of the national convention of the American Foundrymen's Association reported that no meeting had been held in the past month, but that some points had been agreed upon subject to change. It was said that some 1,000 to 1,200 persons were expected to attend, for whose entertainment $8,000 to $10,000 would be needed. All foundrymen are invited to attend the convention, but those not identified with any association will be expected to contribute toward paying for the entertainments to be provided.

W. A. Pollock Davis was to have read a paper on "The Introduction of Nickel and Molybdenum Alloy in Foundry Practice," but sent word that he was detained in Baltimore. In his absence Vice President A. E. Outerbridge, who occupied the chair in the absence of President Devlin, gave a little talk on his experiences in the use of alloys in making castings.

Molding Machine Exhibit.

Molding machines of the squeezer, vibrator, roll-over and jarring types were shown in operation at the monthly meeting of the Pittsburg Foundrymen's Association held at the Carnegie Technical Schools, Pittsburg, Monday, Feb. 4. The machines were exhibited in the school foundry, which is a commodious building where the rudiments of molding are taught. The attendance of foundrymen, which was large, was augmented by the presence of a large number of students, who manifested great interest in the operation of these machines. After the exhibition the visitors were conducted on an inspection tour through the schools. Machines were shown by the E. H. Mumford Co., Philadelphia; the Tabor Mfg. Co., Philadelphia, and the Herman Pneumatic Machine Co., Zelienople, Pa.

A. F. A. Convention.

Dr. Richard Moldenke, Watchung, N. J., secretary of the American Foundrymen's Association, has issued the official convention announcement, which states that the annual gathering will be held in Philadelphia, May 21 to 24, 1907. The entertainment program, which includes a Philadelphia river trip and a Washington park shad dinner, will be limited strictly to members, visiting ladies, members of affiliated associations, delegates interested in the organization of the Brass Founders' Association, and guests who secure the proper credentials for the special entertainment at the time of registration from the secretary of the association, who alone has been designated to pass on these matters. Others will be asked to contribute the sum of $5, which will be considerably short of the actual cost. The meeting and the exhibits will be held at the Second Regiment Armory. A special circular letter will be issued and sent to brass foundrymen who have already signified their interest in the proposed Brass Founders' Association which will be organized during the convention. Arrangements are now being made for special railroad rates.

New York Foundry Foremen.

The New York branch of the Associated Foundry Foremen held its monthly meeting in the Grand Union hotel on Saturday evening, January 26. The attendance was large, as the program provided for a talk on "Molding Machines," given by E. H. Mumford, of the E. H. Mumford Co., Philadelphia. The multiple molding machine described was illustrated with stereopticon views, and Mr. Mumford explained in detail many of the problems which have been solved by this method of molding. Mr. Stimpson, instructor in foundry practice at Pratt Institute, showed a number of views which followed the production of pig iron from the unloading of the ore to the casting

of the pigs in both sand and chills. He was assisted by Bradley Stoughton, of the School of Mines, of Columbia University, who explained some of the details of blast furnace operations. Panoramic views of the city of Venice were also shown. The meeting of March 24 will be preceded by a dinner and the program provides for several interesting addresses.

Foundry Foremen of Philadelphia and Vicinity.

The 24th annual meeting of the Associated Foundry Foremen of Philadelphia and vicinity was held on Monday, February 11. The making of molds for large castings, weighing the copes, anchoring the cores, building the runners, and pouring the molds, were the subjects discussed.

A theatrical benefit for the purpose of raising funds to defray the expenses of entertaining delegates to the convention of the American Foundrymen's Association, which will be held in Philadelphia in May, was decided upon and tickets were distributed. An effort will be made to interest the foundrymen of Philadelphia and the immediate vicinity in this entertainment.

Cleveland Club of Associated Pattern-maker Foremen.

The regular monthly meeting of the Cleveland Club of Associated Pattern-maker Foremen was held Monday evening, Feb. 11, and marked the second anniversary of this organization. That it is in a flourishing condition was indicated by the attendance and the interest manifested in the proceedings. H. J. McCaslin read a short paper showing the advantages of making a rough mold of the exterior form of a casting, which would not only show the most economical and practical manner of molding, but would also determine the construction of the pattern. The members also discussed the advisability of preparing a general paper to be read at the convention of the American Foundrymen's Association on a subject which will be decided upon later. The next meeting will be held on Monday, March 11.

New England Foundrymen's Association.

The monthly meeting of the New England Foundrymen's Association was held at the Exchange Club, Boston, Wednesday, Feb. 13. The committee appointed at the January meeting to investigate the tariff on southern iron reported that it had entered a protest with the Interstate Commerce Commission, but up to that time had received no reply. Advices were received from the railroad companies, however, that the advance scheduled to take effect February 1 had been deferred to March 3. The committee further reported that it had taken this matter up with various Foundrymen's Associations, urging their co-operation in this movement. A communication was read from the Philadelphia Foundrymen's Association stating that at its last meeting a resolution was passed opposing this advance and that the question of tariff on southern iron would be taken up vigorously with the Interstate Commerce Commission.

After dinner the chairman introduced Henry M. Lane, of Cleveland, who gave a very interesting talk on "Foundry Metallurgy," illustrated by stereopticon. His remarks were confined largely to the relationship between the percentage and volumes of the elements in cast iron. He also exhibited samples of various impurities in a metallically pure state which were passed among the members for examination.

Geo. H. Wadsworth, of the Falls Rivet & Machine Co., Cuyahoga Falls, O., in a paper on "Core Room Practice, Past and Present," pointed out the rapid advancement made in core room practice in recent years. He stated that little attention was given this department by the operating heads of foundries and as a result many of them were located in out of the way places or in dark corners. This, however, applied particularly to small jobbing foundries, he stated, inasmuch as in many of the modern plants the core rooms have been as well taken care of in regard to light and equipment as any other part of the foundry. On the sub-

ject of core machines he said that this equipment is coming into use more generally, as his company alone builds five different sizes and types. The first machine placed on the market by his concern made cores ranging in size from ⅜ to 1½ inches and the machine was what is generally known as the sausage stuffing type. The same machine was later increased in size and became a standard at 2¼ inches for two or three years. The later machines were built for making cores up to 5 inches and later up to 7 inches.

Mr. Wadsworth had a number of machines on display and made a 7-inch core 24 inches long in a fraction of a minute. He also showed the company's speed changing machine, which has a slip gear which permits of a change of speed for the making of large and small cores. Another machine was shown which made slab cores in sizes from ⅝ inch x 4 inches and 24 inches long, to 1½ inches by 9 inches by 24 inches long. The multiple machine exhibit made six 1-inch round cores at a time. This machine, he stated, was designed to make knob cores 0.298 of an inch square and he was allowed a variation of 0.002 of an inch, that is, 0.001 under and 0.001 over size. Considerable interest was manifested in the exhibition by the members, and a vote of thanks was extended to both speakers.

Foundry Supply Association.

During the past few weeks the Foundry Supply Association has enjoyed a rapid growth in membership, eighteen concerns, including foundry supply and equipment dealers and manufacturers, having made application for enrolment. Space in the Second Regiment Armory, Philadelphia, where the exhibit will be held during the week of the convention of the America Fonundrymen's Association, is being rapidly allotted and only a small section is still available.

An "Otto" gas engine, which will drive a Crocker-Wheeler generator, has been installed for the exhibitors desiring direct current, while the remainder of the power will be furnished by alternating current motors. One of the many features of the exposition will be the large number of oil melting furnaces which will be shown in the adjoining lot, where the heavier pieces of equipment requiring foundations or pits will be located The machinery will be protected by temporary buildings, which will soon be under construction.

The complete enrolment of the Foundry Supply Association follows:

Addy & Co., Matthew, Philadelphia.
Arcade Mfg. Co., Freeport, Ill.
Berkshire Mfg. Co., Cleveland.
Bonvillain, Ph., & E. Ronceray, Paris, France.
Borgner & Co., Cyrus, Philadelphia.
Buffalo Forge Co., Buffalo.
Byram & Co., Detroit.
Cleveland Wire Spring Co., Cleveland.
Crocker-Wheeler Co., Ampere, N. J.
Detroit Foundry Supply Co., Detroit.
Detroit Testing Laboratory, Detroit.
Dings Electro-Magnetic Separator Co., Milwaukee.
Dixon Crucible Co., Joseph, Jersey City.
Emmert Mfg. Co., Waynesboro, Pa.
Evans Stamping & Plating Co., Taunton, Mass.
Falls Rivet & Machine Co., Cuyahoga Falls, O.
Goldschmidt Thermit Co., New York.
Hanna Engineering Works, Chicago.
Herman Pneumatic Machine Co., Zelienople, Pa.
Hill & Griffith Co., Cincinnati.
Holland Linseed Oil Co., Chicago.
Interstate Sand Co., Cleveland.
Johnston, T. P., New York.
Kelley Co., T. P., New York.
Killing Molding Machine Co., Davenport, Ia.
Koppel Co., Arthur, New York.
Lamson, Thomas F., Boston.
Lindsay & Co., W. W., Philadelphia.
Link-Belt Co., Philadelphia.
McCormick Co., The J. S., Pittsburg.
Mills Oil Co., C. E., Syracuse, N. Y.
Mitchell-Parks Mfg. Co., St. Louis.
Mumford Co., The E. H., Philadelphia.
Obermayer Co., The S., Cincinnati.
Osborn Mfg. Co., Cleveland.
Otto Gas Engine Works, Philadelphia.
Pangborn, Thomas W., New York.
Paxson Co., J. W., Philadelphia.
Penton Publishing Co., The, Cleveland.
Pettinos Bros., Bethlehem, Pa.
Pilling & Crane, Philadelphia.
Pridmore, Henry E., Chicago.
Robeson Process Co., Camden, N. J.
Rockwell Engineering Co., New York.
Rogers, Brown & Co., Cincinnati.
Seidel, Inc., R. B., Philadelphia.
Sly Mfg. Co., The W. W., Cleveland.
Smith Foundry Supply Co., The J. D., Cleveland.
Southern Machinery Co., Atlanta.
Standard Sand & Machine Co., Cleveland.
Tabor Mfg. Co., Philadelphia.

U. S. Graphite Co., Saginaw, Mich.
Wells Light Mfg. Co., New York.
Western Foundry Supply Co., East St. Louis, Ill.
Wilbraham-Green Blower Co., Philadelphia.
Whiting Foundry Equipment Co., The, Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Philadelphia Entertainers.

Thos. Devlin, president of the Philadelphia Foundrymen's Association, has appointed the committee which will provide the entertainment during the convention of the American Foundrymen's Association which will be held in Philadelphia, May 20 to 24. It is made up as follows:

E. E. Brown, E. E. Brown & Co.
A. E. Outerbridge Jr., Wm. Sellers & Co.
S. G. Flagg Jr., S. G. Flagg & Co.
C. W. Asbury, Enterprise Mfg. Co.
J. M. Jaycox, Ernest Law & Co.
W. S. Hallowell, Harrison S. B. Works.
Geo. C. Davies, Pilling & Crane.
W. O. Steele, Bateman Mfg. Co.
Geo. R. Sullivan, Rogers, Brown & Co.
E. H. Mumford, E. H. Mumford Co.
Thos. Evans, Eynons-Evans Mfg. Co.
Edgar S. Cook, Warwick Iron Co.
J. H. Sheeler, Sheeler-Hemsher Co.
Cyrus Borgner, Cyrus Borgner Co.
A. A. Miller, *The Iron Age.*
W. H. Ridgway, C. Ridgway & Sons Co.
W. W. Hearne, Matthew Addy Co.
J. Thompson, J. Thompson & Co.
Frank Krug, Jos. Dixon Crucible Co.
Wm. H. Taylor, Geo. V. Cresson Co.
A. C. Mott, Abram Cox Stove Co.
Franklin L. Sheppard, I. A. Sheppard & Co.
Harry W. Hand, Wm. Cramp & Son Ship & Engine Building Co.
John Glover, Glover Bros.
Jas. S. Stirling, Hilles & Jones Co.
H. L. Haldeman, Pulaski Iron Co.
Walter Wood, R. D. Wood & Co.
W. F. Sauter, Williamson Bros. Co.
H. L. Tripple, Fairbanks Co.
Thos. Devlin, Thos. Devlin Mfg. Co.
Howard Evans, J. W. Paxson Co.

Association Directory.

AMERICAN FOUNDRYMEN'S ASSOCIATION.
Dr. Richard Moldenke, Secretary, Watchung, N. J.

BRITISH FOUNDRYMEN'S ASSOCIATION.
F. W. Finch, Secretary, Kingston House, Lonsdown Rd., Gloucester, Eng.

BUFFALO FOUNDRYMEN'S ASSOCIATION.
John E. Gorss, Secretary, Builders' Exchange, Buffalo.

NEW ENGLAND FOUNDRYMEN'S ASSOCIATION.
Fred F. Stockwell, Secretary, Barbour-Stockwell Co., Cambridgeport, Mass.

PACIFIC COAST FOUNDRYMEN'S ASSOCIATION.
J. D. Morris, Secretary, Seattle, Washington.

PHILADELPHIA FOUNDRYMEN'S ASSOCIATION.
Howard Evans, Secretary, J. W. Paxson Co., Philadelphia.

PITTSBURG FOUNDRYMEN'S ASSOCIATION.
F. H. Zimmers, Secretary, Union Foundry & Machine Co., Pittsburg.

FOUNDRY SUPPLY ASSOCIATION.
H. M. Lane, Secretary, Schofield Bldg., Cleveland.

THE ASSOCIATED FOUNDRY FOREMEN.
Frank C. Everitt, Secretary, J. L. Mott Iron Works, Trenton, N. J.

CHICAGO FOUNDRY FOREMEN.
C. J. Wiltshire, Secretary, Western Electric Co., Chicago.

CINCINNATI FOUNDRY FOREMEN.
E. W. Cadwell, Secretary, Peerless Foundry Co., Hamilton, O.

CLEVELAND FOUNDRY FOREMEN.
H. M. Lane, Secretary, Schofield Bldg., Cleveland.

ERIE FOUNDRY FOREMEN.
W. F. Grunau, District Vice President, Erie City Iron Works, Erie, Pa.

HAMILTON, ONT., FOUNDRY FOREMEN'S ASSOCIATION.
A. Chase, Secretary, Sawyer & Massey Co., Hamilton, Ont.

INDIANAPOLIS FOUNDRY FOREMEN.
W. S. Keller, District Vice President, Hetherington & Berner Co., Indianapolis.

NEW YORK FOUNDRY FOREMEN'S ASSOCIATION.
W. S. McQuillan, Secretary, Colonial Foundry Co., So. Norwalk, Conn.

PHILADELPHIA FOUNDRY FOREMEN.
W. P. Cunningham, Secretary, American Bridge Co., Pencoyd, Pa.

CLEVELAND CLUB OF ASSOCIATED PATTERNMAKER FOREMEN.
H. J. McCaslin, Secretary, Wellman-Seaver-Morgan Co., Cleveland.

GENERAL INDUSTRIAL NOTES.

The Maynard Steel Foundry Co., Milwaukee, Wis., has been incorporated with a capital stock of $6,000. Small and medium weight crucible steel castings will be manufactured, including sections required in automobile manufacture. It is expected that the company will have its new plant in operation early in March.

The Lake Erie Foundry Co. has been incorporated with a capital stock of $10,000 by Philip Keipper, A. G. Bartholomew and S. L. Brown. The new company will take over the business formerly conducted by Philip Keipper, Buffalo, under the name of the Niagara Foundry Co.

The National Steel Foundry Co., which is closely allied with the National Wire Corporation, New Haven, Conn., both of which are controlled by the National Steel & Wire Co., has been placed in the hands of H. Stuart Hotchkiss and Frederick B. Farnsworth, as receivers.

The Wetherill Finished Castings Co., Philadelphia, has been organized by S. P. Wetherill, J. P. Wetherill and S. P. Wetherill Jr., to manufacture various kinds of castings under processes controlled by the owners.

The United Foundry & Machine Co., Canton, O., has been incorporated with a capital of $10,000. The company will do a general jobbing business in a plant already secured, and expects to take up malleable work in the spring. George P. Bonsky is president and general manager; George F. Ebel, vice president, and August Reichert, secretary and treasurer.

The Modern Novelty & Brass Co., Elwood, Ind., has been organized with a capital of $25,000. Louis N. Puppenletz, Alva Favors, and George H. Gilpatrick are the incorporators.

The Lobee Pump & Machinery Co., Buffalo, has recently added a foundry for the manufacture of brass and bronze castings.

The Heimann Foundry & Machinery Co., Massillon, O., has been organized with a capital of $50,000 by M. W. Oberlin, F. G. Harrison, A. A. Reise, and H. C. Dielhen.

The Quincy Brass Works, Chicago, has been organized with a capital of $10,000 by Frank Parisek, Percy F. De Tamble, and Alfred Livingston.

The plant of the Matthews Steel Casting Co., Matthews, Ind., has been purchased by William S. Freeman, W. B. Moore, and George Swift, of Chicago, who have organized the Armor Steel & Foundry Co., and will immediately place the plant in operation. The company has been organized with a capital of $25,000 and the foundry will be operated by P. M. Reilly, who has been appointed superintendent.

The Orr Foundry, Orrville, O., which was recently erected by Chas. Henderson and George Wendling, has been placed in operation.

The Ohio Steel Foundry Co. has been organized with a capital of $400,000 for the purpose of erecting a steel foundry at Lima, O. Ground has already been broken for the erection of a new plant, which will probably be completed early in the summer. The officers of the company are Harry Wright, president; J. E. Galvin, vice president; and John W. Kaufman, secretary.

The New Bedford Foundry & Machine Co., New Bedford, Mass., has been incorporated with a capital of $15,000. Edward L. Besse, Fairhaven, Mass., is president; Seth J. Besse, New Bedford, Mass., treasurer. They, with A. G. Caswell and F. D. Stetson, constitute the board of directors. The company has not yet announced its manufacturing plans.

The new malleable iron foundry of the Pittsburg Valve & Fittings Co., Barberton, O., has been placed in operation.

Application has been made for a charter for the Acme Foundry Co., Pittsburg. Machinery and mechanical appliances will be manufactured from iron, steel, brass, copper and other metals. Marcellin C. Adams, Edward Oberndorf and Sidney S. Klinardlinger are the incorporators.

The Stowell Mfg. & Foundry Co., South Milwaukee, Wis., has increased its capital stock from $200,000 to $300,000. The foundry capacity will be increased and other improvements will be made to its plant.

The Pittsburg Reduction Co., Pittsburg, manufacturer of aluminum, has changed its name and will hereafter be known as the Aluminum Co. of America.

The Capitol City Foundry Co., Trenton, N. J., has been incorporated with a capital of $25,000, for the manufacture of gray iron and brass castings. The incorporators are: W. R. Sweeney, B. Schluher and A. Knapp, Trenton.

The Arcade Mfg. Co., Freeport, Ill., manufacturer of molding machines and hardware specialties, has doubled the capacity of its plant during the past year and is planning further extension.

The Darlington Foundry Co., Darlington, Pa., has been incorporated by E. M. Peters, S. L. Riddle, J. M. Davis, S. R. Elder, and E. W. Cole.

The plant formerly occupied by the Bissell Chilled Plow Works, South Bend, Ind., has been taken over by the Ideal Concrete Machinery Co. The buildings include a foundry, which will not be operated for the present.

The A. C. Spalding & Bros. Mfg. Co., Chicopee, Mass., will operate the Ames foundries, which it recently purchased for the manufacture of bronze work, and may later engage in the manufacture of lathes.

The Union Iron & Brass Works, El Paso, Tex., recently incorporated with a capital of $50,000, has purchased a large brick building and is remodeling this in order to provide for a more extensive business. The company operates iron and brass foundries, machine shop, etc.

The Sandusky Foundry & Machine Co., Sandusky, O., has increased its capital stock from $50,000 to $100,000, and has taken over the plant of the Co-operative Foundry & Machine Co., of that city, which has been in the hands of a receiver. New machinery will be installed in the foundry and machine shop. W. H. Milspaugh is president, Sidney Frohman secretary, and J. J. Dauch treasurer.

The Madison Stove Foundry, Madison, Ind., has been purchased by Fred Eckert, and will be operated by a company formed by Fred Eckert, Louis Sulzer and I. Stern.

The Century Telephone Construction Co. has purchased the buildings of the plant of the General Railway Signal Co., at Buffalo, which the latter company recently vacated, for $250,000.

The Barlow Foundry Co. has taken over the malleable and gray iron foundry business hitherto conducted by Arthur E. Barlow at Newark, N. J.

V. R. and E. H. Browning, of the Browning Engineering Works, Cleveland, have purchased the property of the Mansfield Engineering Co., Mansfield, O., and will conduct it along the same lines as the Browning Engineering Co.

Efforts are being made by John B. Newkirk and I. Roberts Newkirk, of John B. Newkirk & Co., Philadelphia, to reorganize the Diamond State Steel Co., of Wilmington, Del. They have announced that a new company has been formed to pay over the $575,000 bid at public auction for the plant by the Newkirk Co.

The William M. Cowan Foundry & Machine Co., Augusta, Me., has been incorporated with a capital of $150,000 by W. M. Cowan, of Lynn, Mass., and L. A. Burleigh.

The Girard Foundry & Machine Co., Girard, O., has been organized with a capital of $15,000, by T. C. Thomas J. C. Hillenbrand, F. H. Lightle, G. J. Jones, and William C. Wallis.

The Humphreys Mfg. Co., Mansfield, O., announces that it is in position to meet the requirements of manufacturers who are seeking high-class brass foundry facilities. The company is prepared to fill orders for brass castings of any composition and for any class of service, as well as bronze, copper or aluminum specialty castings.

The Canadian Foundry Co., Toronto, will engage in the construction of Bucyrus steam shovels weighing 90 tons each, which have hitherto been imported from the United States. Large contracts have been placed with the company by the Canadian Pacific and Canadian Northern railways.

The Winnipeg Foundry Co., Ltd., Winnipeg, Man., with $20,000 capital stock, has been incorporated by Joseph T. Hill, Harvey Bell, Wesley A. Armstrong, Alex D. Irish, Arthur J. Brown and F. W. Irish.

The Green Engineering Co., Chicago, has increased its capital from $75,000 to $200,000 to cover the erection of its plant at East Chicago, Ind. The company manufactures chain grate stokers.

The Orr Foundry Co., Orrville, O., has been incorporated with a capital of $10,000 by George Wendling, C. O. Henderson, S. M. Brenneman, Chris Smith and B. G. Cope.

The Wendt Coupler Co., Marshfield, Wis., has been incorporated with a capital stock of $50,000 for the manufacture of railroad car equipment. A specialty will be made of a patented coupler, of which Fred H. Wendt is the inventor. A new steel foundry will be erected at once, work upon which will be commenced at an early date.

L. F. Fales, Walpole, Mass., manufacturer of machinery, has leased the foundry formerly operated by the Clark Machine & Foundry Co., Franklin, Mass., and has begun its operation under the management of David Spence, recently superintendent of the foundry of the Golding Machine Co. Jobbing work will be done, in addition to the manufacture of castings for use in Mr. Fales' works.

The American Foundry Supply Co., Cleveland, recently incorporated with a capital of $10,000 to manufacture molders' tools, will at once build a plant 100 x 100 feet. New equipment will be required. The incorporators are: E. G. Heyner, David H. Richards, Elizabeth Jones, W. B. Jones and Martha Brewster.

The C. A. Driesbach Foundry & Machine Co. has been organized at New Haven, Conn., to manufacture structural, machinery, furnace and hardware castings. It is a Connecticut corporation, with $20,000 capital stock. The incorporators are Charles A. Driesbach, recently with the McLagon Foundry, Augustus L. Williams, and George W. Hall. The company will establish a foundry for gray iron work and will operate a machine shop to do work in connection with casting contracts. The works will be located in New Haven, on a site which will give both water and railroad facilities. Further details of the plans are not yet ready for announcement.

The Geneva Foundry & Machine Co., Geneva, Ill., has increased its capital stock from $5,000 to $7,200.

The Watt Mining Car Wheel Co., Barnesville, O., has, owing to the death of its president, R. R. Watt, elected new officers, as follows: President and treasurer, J. W. Watt; vice president and superintendent, S. Watt, and secretary and general manager, P. H. Laughlin.

The Trinidad Foundry & Machine Co., Trinidad, Colo., has recently been incorporated with a capital stock of $50,000, by Merdo Mackenzie, J. C. Hudelson, W. M. Rapp, and F. J. Radford. The new organization, which will absorb the Trinidad Foundry & Machine Works, will manufacture mine cars, mine equipment and machinery castings. Within a few months it will increase its present capacity by the erection of a foundry 64 x 128 feet, and a machine shop 54 x 128 feet, which will be equipped with modern machinery.

The Perfection Spring Co., Cleveland, manufacturer of the McIntyre double-duplex spring, has increased its capital stock from $20,000 to $50,000.

The B. F. Sturtevant Co., Boston, Mass., has recently received orders for its new type of high pressure rotary blowers from the General Fire Extinguisher Co., Atlanta, Ga.; Rivett Lathe Co., Brighton, Mass.; Wayne Agricultural Works, Goldsboro, N. C.; J. B. Clark

Mfg. Co., Rockford, Ill.; N. Y. Continental Jewel Filtration Co., New York City; Winchester Repeating Arms Co., New Haven, Conn.; Salem Glass Co., Salem, N. J.; and Eastern Chemical Co., Boston, Mass.

Michael H. Fallon has been elected president of the Reynolds-Chalou Foundry Co., Troy, N. Y. The other officers are: Joseph Mackey, vice president and secretary, and Frank M. Brady, treasurer. These officers also constitute the board of directors.

The Standard Sand & Machine Co., Cleveland, has shipped a complete sand handling plant to the Standard Ideal Co., Ltd., Port Hope, Canada. Similar equipment is being built for the Detroit car wheel plant of the American Car & Foundry Co. The Standard Sand & Machine Co. will in future also make a specialty of conveying machinery for all kinds of material.

The Cleveland Castings Pattern Co. was recently organized with the following officers: F. W. Wood, president; A. K. Spencer, vice president; D. G. Miller, secretary and treasurer; V. G. Farner, superintendent. The new company has purchased the plant of the Gobeille Pattern Co., which has been in business in Cleveland for the past twenty-five years, and will double its capacity. It already has many large contracts, including engine patterns for the Nagle Engine & Boiler Co., Erie, Pa., and work for the American Locomotive Co.

The Galesburg Malleable Castings Co., Galesburg, Ill., has been organized by Dyke Williams, Thos. B. Maiston and W. S. Carson, with a capital of $60,000.

The Modern Foundry Co., Oakley, O., has been chartered by Fred A. and P. A. Geier, C. Wood, Walter and Charles S. Gingrich. The company will erect a grey iron foundry to supply castings to a group of manufacturers to be located at that place.

The Farrell Foundry & Machine Cos., allied concerns of Waterbury and Ansonia, Conn., respectively, have increased their capital stock. The increase of the Waterbury company is from $400,000 to $440,000, and of the Ansonia company from $1,150,000 to $1,200,000.

The Des Moines Foundry Co., Des Moines, Ia., has been incorporated with a capital of $60,000, for the manufacture of cast iron soil pipe and fittings. The officers are: W. H. Arnold, president; B. F. Cummings, vice president; Olin J. Sweet, treasurer; C. R. Harper, secretary and general manager.

The Vanderpoel Co., Chicago, has changed its name to the American Building Foundry Co.

New Construction.

The St. Louis Malleable Casting Co., St. Louis, manufacturer of malleable and gray iron castings, has decided to double the capacity of its plant and will erect two new buildings, respectively 320 x 60 feet and 120 x 80 feet. Two melting furnaces will be added, which will increase the daily capacity 25 tons, and six annealing ovens will be erected to handle this increased tonnage, as well as other equipment necessary for the handling of this material. The cost of the improvements approximates $25,000 and arrangements have been made for the employment of 250 additional men by March 15. Officers have been elected as follows: Geo. J. Kobusch, president; Geo. C. Diederich, first vice president; Edward Westen, second vice president; Chas. G. Ette, secretary and treasurer.

The Van Buren Foundry, Van Buren, Ark., recently destroyed by fire, will be rebuilt. An L-shaped building, 30 x 32 x 127 feet, will be erected at a cost of $35,000 for building and equipment. James Morell is proprietor of the plant.

William Resor & Co., Cincinnati, whose foundry plant was recently heavily damaged by fire, are preparing to erect a new building. This will be of brick and stone, five stories, 160 x 350 feet.

North Bros., Philadelphia, have awarded the contract for an addition to their foundry. The building will be 39 x 50 feet, one-story, and will cost $2,700.

The Modern Foundry Co., recently incorporated with a capital stock of $350,000, will erect a large plant for the manufacture of grey iron castings at Oakley, a suburb of Cincinnati. The incorporators are F. A. Geier, C. Wood Walter, E. M. Chase, C. F. Gingerich and P. O. Geier.

Gartland Bros., Kankakee, Ill., will erect an addition to their foundry, 60 x 200 feet. This addition will enable them to increase their working force to 100 men.

The Griffin Wheel Co., Chicago, has prepared plans for the erection of a second car wheel plant at Pullman, Ill. This company recently completed a 600-wheel straight line foundry at this place to supply the demand of the Pullman Co., whose plant adjoins this property. The foundry will be of steel and concrete construction, 300 feet square. The melting equipment will consist of three 100-inch cupolas, and the charging floors will have an area of 50 x 222 feet. The core shop will be 2½ stories high and 59 x 100 feet in dimensions. The cleaning room platform will have an area of 19 x 300 feet, and the old wheel platform an area of 90 x 400 feet. A carpenter shop 19 x 70 feet will also be built, as well as a machine shop 2½ stories high and 59 x 100 feet. A 2-story office building will also be erected 30 x 62 feet. The building plans are being prepared by Harry E. Stevens, architect, 2146 West Monroe street, Chicago.

The Novelty Iron Works, Sterling, Ill., is preparing plans for the erection of an addition to its foundry, 50 x 18 feet.

The Colorado Gray Iron Foundry Co., has been organized at Denver, Colo., to engage in the manufacture of gray iron castings. A foundry, 110 x 250 feet, will be built, as well as a pattern shop 60 x 130 feet, the building to be of brick construction. The officers of the company are: J. M. Herbert, president; S. C. Williamson, secretary and treasurer; F. S. McNamara, general manager.

The Murphy Foundry & Mfg. Co., Ocean Grove, N. J., will erect an addition 25 x 75 feet, and will also add a 5-ton cupola.

The Gies Gear Co., Detroit, will erect a foundry 40 x 60 feet.

The Champion Machinery Co., Joliet, Ill., has purchased additional property to erect a new foundry for the manufacture of castings for its own use. Work on the new plant will be begun at once.

Extensive additions, including a foundry building, 121 x 75 feet, will be made to the plant of the Goodell-Pratt Co., Greenfield, Mass. Work will begin in the early spring.

The Benton Harbor Malleable Iron Foundry, Benton Harbor, Mich., will soon commence the erection of a new foundry, the cost of which will be about $20,000.

The contract has been awarded for the new foundry building of the Blaisdell Machinery Co., South Bradford, Pa. This will be of brick and steel construction, 61 x 80 feet. Additions to the storage warehouse are also planned.

The Jenney Safety Switch Co., Westfield, Mass., manufacturer of a new safety device, is planning to erect a foundry, machine shop, and drop forging plant at Westfield. The company is now purchasing its castings.

The Detroit Register Co., Detroit, Mich., is rebuilding its large plant which was recently destroyed by fire, and will require considerable foundry equipment. The company is temporarily occupying the factory vacated by the Stimpson Standard Computing Scale Co., Milan.

The Keystone Driller Co., Beaver Falls, Pa., will shortly begin the construction of a steel foundry adjoining its present plant. The castings will be used principally in the manufacture of drilling machinery.

The Becker-Brainard Milling Machine Co., Hyde Park, Mass., has completed an addition, two stories, 30 x 90 feet, which will be used as a foundry and core room.

The Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., intends to build another addition to its plant and has already placed orders for the necessary equipment.

The Patric Furnace Co., Springfield, O., will erect another foundry. The building will be of concrete and steel, and will be about 68 x 110 feet.

The Barcalo Mfg. Co., Buffalo, N. Y., maker of brass and iron bedsteads, is adding to its plant a foundry, 95 x 185 feet, and will erect a three-story addition to its factory in the spring.

The Victor Knecht Co., Cincinnati, will begin the construction of a new foundry which will cost approximately $100,000, early in the spring. A site has been secured in the west end of the city.

Contracts have been awarded by the Coffeyville Machine Shop & Foundry Co., Coffeyville, Kan., for three buildings, one 60 x 100 feet, another 48 x 100 feet, and a third 50 x 45 feet. The buildings are extensions to the foundry and machine shops of the present plant.

The Oriskany Malleable Iron Co., Oriskany, N. Y., is erecting a large steel storage pattern building.

The Walker & Pratt Mfg. Co., Watertown, Mass., is planning to erect a foundry and warehouse, 101 x 182 feet.

The Falls Machine Co., Sheboygan Falls, Wis., is planning to erect a foundry and machine shop to cost $90,000.

The Ross-Meehan Foundry Co., Chattanooga, Tenn., has awarded the contracts for a new pattern shop which will be 60 x 200 feet.

The Central Steel Casting Co., Columbus, O., recently incorporated, has changed its name to the Bonney-Floyd Co. A site of 11½ acres on the Toledo & Ohio Central railroad has been purchased, on which a new steel casting plant will be erected.

The Nute Foundry Co. has been organized with $30,000 capital by T. C. Nute and O. M. Sherbert, who have been operating a foundry under the name of the T. C. Nute Co., in Akron, O. The company will locate in Cuyahoga Falls, O., where a new foundry, with main building 50 x 100 feet, will be erected at once. The new plant will have a much larger capacity than the old.

The Nordberg Mfg. Co., Milwaukee, Wis., manufacturer of heavy machinery castings, will erect a new foundry near its present plant, at an estimated cost of $350,000. The contract, which calls for the completion of the work by Oct., 1, has been let. The new building will be 240 x 425 feet, of brick and steel construction, and will be equipped with three cupolas.

The Peninsular Motor Co., Grand Rapids, Mich., is building a foundry which will have a molding room 50 x 98 feet, a cleaning and shipping room 20 x 50 feet, also fireproof pattern room and cupola room, with floors of reinforced concrete. Storehouses will also be erected, and a machine shop will be added later. The company specializes in the manufacture of gas engine castings.

The Geo. H. Smith Steel Casting Co., Milwaukee, manufacturer of crucible and high manganese steel castings, is now preparing plans for extensions to its foundry. A new building, 60 x 240 feet, of steel construction throughout, will be erected, which will be served by two 10-ton electric traveling cranes, which will increase the total number of cranes in this company's plant to eight. The floor space will be increased to a total of 100,000 square feet.

Fires.

The plant of the So. Atlantic Car & Mfg. Co., located three miles southwest of Savannah, Ga., was destroyed by fire Jan. 17, the loss of $300,000 being partly covered by insurance.

The foundry of the McMyler Mfg. Co., Cleveland, was destroyed by fire on Jan. 17, causing a loss of $10,000. This company has another plant in Cleveland and one in Warren, O., and it is announced that the foundry will be rebuilt.

The foundry of the Rogers-Conklin Mfg. Co., Joplin, Mo., was destroyed by fire on Jan. 18, with a loss of $5,000, covered by insurance.

THE CRANDALL CUPOLA

The most modern product in Cupolas in 20 years.

Our Cupola will save in fuel in one year's time sufficient to pay for itself.

Matter sent to Columbus Brass Co., Columbus, Ohio.

"Actions speak louder than words." An old saying and a true one. Here is the story of a Cupola in four acts.

1st Act. March 22, 1902, our Mr. Crandall while traveling for a competitive house, sold to the Crown Pipe & Foundry Co., Jackson, Ohio, a No. — Cupola, 63 in. Diameter.

2nd Act On August 19th, 1903, he sold them (for their No. 2 Foundry) a No. — Cupola 72 in. diameter, which Cupola they did not erect until January, 1906.

3rd Act. Mr. Crandall sold them our Crandall attachment for the No. 7 Cupola, consisting of Wind Box and Tuyers which replaced —— tuyers in No. 1 Cupola.

4th Act November 19, 1906, he sold them a No. 2 Crandall Cupola, 86 in. diameter, to take the place of the No. — purchased in March, 1902.

SYNOPSIS:

Two Cupolas—one changed to our bosh construction, the other replaced by a Crandall after the first had been thoroughly tried out.

The Columbus Brass Co. referred the above to the Crown Pipe & Foundry Co., who replied as follows:

Jackson, Ohio, November 28, 1906.

The Columbus Brass Co.,
Columbus, Ohio.

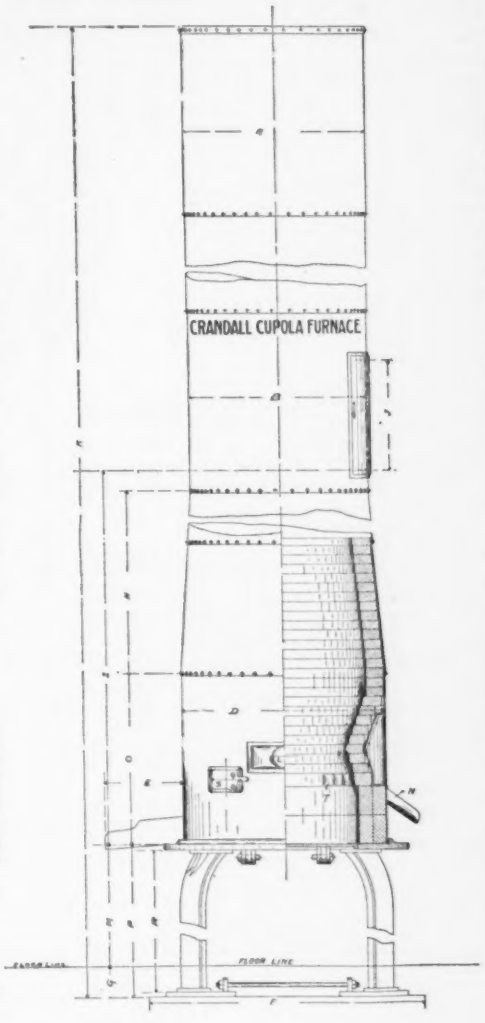
Gentlemen:

Relative to the memorandum which you sent us regarding our purchase of Cupolas and Cupola attachments from Mr. Crandall, the statements made therein are correct, with the single exception that the tuyers referred to in what is designated as "3rd Act" were for our No. 2 Foundry instead of our No. 1. This was probably a stenographic error or at least it is so indicated by the last paragraph designated as "Synopsis."

We are returning herewith your memorandum sent us.

Yours truly,
THE CROWN PIPE & FOUNDRY CO.,
By A. C. Dugan, (Signed), Secy. and Treas.

(The Columbus Brass Co. sent us their order.)



We build all kinds of Foundry Equipment.

We grind our own facing.

A complete stock at our Detroit and Windsor plants.

Our catalogue of Foundry Furnishings---the most complete ever issued---will be ready for mailing in March.

The Detroit Foundry Supply Co.

DETROIT, MICH. WINDSOR, ONT.

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SOLID SPANISH FELT WHEELS

¶ Of all the different polishing wheels used, the Spanish Felt Wheel is in most general use.

¶ It may be used for roughing, grinding, polishing and finishing, and then when glue and emery are removed and a little Crocus, Rouge or STEVENS' SILVER FINISH is applied, it brings out the beautiful color so much desired.

¶ These wheels are most effective in buffing nickel plated castings when it is desired to keep the background a dead white.

¶ My felt wheels are free from sizings---only hydraulic pressure used to preserve shape. Very firm and solid, and absolutely pure wool.

¶ I manufacture Canvas Wheels, Bull Neck Wheels, and a complete line of Polishing and Plating Compositions---Tripoli Composition, Crocus Composition, Emery Cake, etc.

Pocket-book satisfaction guaranteed.

Send for my catalog for further information.

Frederic B. Stevens,

Cor. Larned & Third Streets,

DETROIT, MICH.

CLASSIFIED

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Advertisers' names are inserted under this heading at the rate of four classifications to each page advertisement carried regularly.

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Norton Company, Worcester, Mass.

Accountants:

Gunn, Richards & Co., New York.
Library Bureau, Systematizing Dept., Boston.

Air Compressors:

American Air Compressor Works, New York.
Chicago Pneumatic Tool Co., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Independent Pneumatic Tool Co., Chicago.
Norwalk Iron Works Co., So. Norwalk, Conn.

Alloys:

Blackwell, Geo., Sons & Co., Ltd. Liverpool, Eng.
New Era Mfg. Co., Kalamazoo, Mich.
Phosphor Bronze Smelting Co., Ltd. Philadelphia.

Analysis—Mechanical:

Keep, W. J., Detroit.

Analysis—Chemical:

Detroit Testing Laboratory, Detroit
Metallurgical Laboratory, Pittsburg.

Anchors:

Lindsay, W. W. & Co., Philadelphia.

Babbitt Metal:

Ajax Metal Co., Birmingham, Ala.
New Era Mfg. Co., Kalamazoo, Mich.

Black Lead:

United States Graphite Co., Philadelphia.

Blowers:

American Blower Co., Detroit.
Connersville Blower Co., Connersville, Ind.
Cornell, J. B. & J. M. Co., New York.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson, J. W. Co., Philadelphia.
Piqua Blower Co., Piqua, O.
Roots, P. H. & F. M. Company, Connersville, Ind.
Sturtevant, B. F. Co., Hyde Park, Mass.

Blowers—Positive Pressure:

Connersville Blower Co., Connersville, Ind.
Piqua Blower Co., Piqua, O.
Roots, P. H. & F. M. Company, Connersville, Ind.
Sturtevant, B. F. Co., Hyde Park, Mass.
Wilbraham-Green Blower Co., Philadelphia.

Brakes (Electric):

Electric Controller & Supply Co., Cleveland.

Brushes:

Osborn Mfg. Co., Cleveland.

Buildings (Struct. Steel):

Lindsay, W. W. & Co., Philadelphia.

Burners (Oil):

Monarch Engineering & Mfg. Co., Baltimore.

Carbonese:

Midvale Mining & Mfg. Co., E. St. Louis, Ill.

Castings (Steel):

Otis Steel Co., Ltd., Cleveland.

Cement (Furnace):

Dixon, Joseph, Crucible Co., Jersey City.
Gautier, J. H. & Co., Jersey City.

Cement (Metallic):

Clark Cast Steel Cement Co., Shelton, Conn.
Shanafelt Mfg. Co., Canton, O.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

Chaplets:

Burdick & Son, Albany, N. Y.
Lindsay, W. W. & Co., Philadelphia.
Shanafelt Mfg. Co., Canton, O.

Coke:

Elliott, Debevoise & Anderson, New York.
Rogers, Brown & Co., Cincinnati.
Surplus Coke Co., New York.

Controllers (Electric):

Electric Controller & Supply Co., Cleveland.

Cores:

Brown Specialty Machry. Co., Chicago.

Core Binders:

Mills, C. E., Oil Co., Syracuse.
National Jeloluse Co., New York.
Robeson Process Co., Camden, N. J.
Sterling Oil Co., Emlenton, Pa.
Young, Frank L., & Kimball, Boston.

Core Compounds:

Young, Frank L., & Kimball, Boston.

Core Machines:

Brown Specialty Machry. Co., Chicago.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Jones & Atwood, Stourbridge, Eng.

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The Imperial Caesar.

You remember him? He became a little too confident and so reached an untimely end.

Constant care is the sign board on the road to success.

The cost of your labor is your greatest cost. In lessening that cost you increase the profit.

Use STEVENS' CARBON BLACKING as a wet blacking or as a core wash, and you reduce the cost of your cleaning or "chipping" department.

That is already proven and I will mail you the proof over signature of twenty representative foundrymen.

Try a barrel---at my risk.

I manufacture an extensive line of Foundry Facings for good service on any mold for any casting. Goods of quality only.

Everything for a Foundry.

FREDERIC B. STEVENS,

Cor. Larned & Third Sts. DETROIT, MICH.

Core Ovens:
Atlas Car & Mfg. Co., Cleveland.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Millett Core Oven Co., Brightwood, Mass.
Pangborn, Thos. W. Co., New York.
Paxson, J. W. Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.

Core Oven Recording Thermometer:
Bristol Co., Waterbury.

Core Tapering Machines:
Brown Specialty-Machinery Co., Chicago.

Cost Keeping Systems.
Gunn, Richards & Co., New York.
Library Bureau, Systematizing Dept., Boston.
Loughry, James C., Elyria, O.

Cranes:
Case Mfg. Co., Columbus, O.
Curtis & Co. Mfg. Co., St. Louis, Ill.
General Pneumatic Tool Co., Montour Falls, N. Y.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia.
Niles-Bement-Pond Co., New York.
Northern Engrng. Works, Detroit.
Pawling & Harnischfeger, Milwaukee.
Ridgway, Craig, & Son, Coatesville, Pa.
Sellers, William & Co., Inc., Philadelphia.
Whiting Foundry & Equipment Co., Harvey, Ill.

Crucibles:
Dixon, Jos., Crucible Co., Jersey City.
Gautier, J. H. & Co., Jersey City.
McCullough-Dalzell Crucible Co., Pittsburg.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson, J. W. Co., Philadelphia.
Ross-Tacony Crucible Co., Philadelphia.
Seidel, R. B., Inc., Philadelphia, Pa.
Taylor, A. L., San Francisco.
Taylor, Robt. J., Inc., Philadelphia

Cupolas:
Byram & Co., Detroit.
Etting, Edward J., Philadelphia.
Gilmour, J., New York.
McCormick, J. S. Co., Pittsburg.
Northern Engrng Works, Detroit.
Paxson, J. W. Co., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Linings:
McCormick, J. S. Co., Pittsburg.
Paxson, J. W. Co., Philadelphia

Drawings for Malleable Melting Furnace:
Buffalo Furnace Works, Buffalo.

Drills:
Chicago Pneumatic Tool Co., Chicago.
Independent Pneumatic Tool Co., Chicago.

Electric Generating Sets.
Sturtevant B. F. Co., Hyde Park, Mass.

Elevators:
Chicago Pneumatic Tool Co., Chicago.
Curtis & Co., Mfg. Co., St. Louis.
Ridgway, Craig, & Son, Coatesville, Pa.

Engines (Steam):
American Blower Co., Detroit.
Sturtevant, B. F. Co., Hyde Park, Mass.

Engineers (Foundry, Mech., Elec., &c.):
Dodge & Day, Philadelphia.
Hooper, Geo. K., New York City.
Lindsay, W. W. & Co., Philadelphia.

Exhausters (Gas):
Wilbraham-Green Blower Co., Philadelphia.

Facings:
Dixon, Jos., Crucible Co., Jersey City.
Doggett, Stanley, New York.
Hill & Griffith Co., Cincinnati.
MacKellar's, R. Sons Co., Peekskill, N. Y.
McCormick, J. S. Co., Pittsburg.
Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.
Pettinos Bros., Bethlehem, Pa.
Smith, J. D., Foundry Supply Co., Cleveland.
Stephens & Co., Kidwelly, Eng.
Stevens, F. B., Detroit.
Western Foundry Supply Co., E. St. Louis, Ill.

Fans:
American Blower Co., Detroit.
Sturtevant, B. F. Co., Hyde Park, Mass.

Ferro-Manganese:
Kendall & Flick, Washington, D. C.
Rogers, Brown & Co., Cincinnati.

Ferro-Silicon:
Roessler & Hasslacher Chemical Co., New York.
Rogers, Brown & Co., Cincinnati.

Fillers (Metallic):
Clark Cast Steel Cement Co., Shelton, Conn.
Shanafelt Mfg. Co., Canton, O.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

Fillets:
Cleveland Fillet Co., Cleveland, O.
Shanafelt Mfg. Co., Canton, O.

Fire Brick:
Gautier, J. H. & Co., Jersey City.
Harbison & Walker, Pittsburg.
Maurer, Henry, & Son, New York.
Laclede Fire Brick Co., St. Louis.
Paxson, J. W. Co., Philadelphia.

Fire Sand:
Carborundum Co., Niagara Falls, N. Y.

Flasks:
Adams Co., Dubuque, Ia.
Barnett, Oscar, Fdy. Co., Newark.
Brass Founders' Supply Co., Newark.
Middleditch, Benj., Detroit.

Flasks (Snap):
Adams Co., Dubuque, Ia.
Diamond Clamp & Flask Co., Richmond, Ind.
Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.

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The Cost of It

The expense of a modern system of cost-keeping need be no greater than a crude, antiquated and inefficient way of keeping accounts.

Such a system is accurate, quick and in ample detail, and it gives the detailed costs of every part of the work while the business is fresh—when it is most valuable as a basis of comparison.

We have studied cost-keeping very carefully and have installed systems which meet these requirements in many well-known foundries.

Will you accord us an interview?

GUNN, RICHARDS & COMPANY

Production Engineers and Public Accountants.....

43 WALL STREET, 43 EXCHANGE PLACE, NEW YORK — 50 CONGRESS STREET, BOSTON

224 ST. JAMES STREET, MONTREAL

Flux:
Basic Chemical Co., Evansville, Ind.

Foundry Engineering:
Lane, H. M., Cleveland.

Foundry Equipment (Iron & Brass):
Barnett, Oscar, Foundry Co., Newark.
Etting, Edward J., Philadelphia.
Obermayer, S. Co., Cincinnati.
Pangborn, Thos. W. Co., New York.
Sly, W. W., Mfg. Co., Cleveland.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.
Wiener, Ernest, Co., New York.

Foundry Supplies:
Detroit Foundry Supply Co., Detroit.
Hill & Griffith Co., Cincinnati.
McCormick, J. S. Co., Pittsburg.
Obermayer, S. Co., Cincinnati.
Osborn Mfg. Co., Cleveland.
Pangborn, Thos. W. Co., New York.
Paxson, J. W. Co., Philadelphia.
Shanafelt Mfg. Co., Canton, O.
Smith, J. D., Foundry Supply Co., Cleveland.
St. Louis Wrecking & Supply Co., St. Louis, Mo.
Stevens, F. B., Detroit.
Taylor, A. L., San Francisco.
Taylor, Robert J., Inc., Philadelphia.

Furnaces (Melting):
Barnett, Oscar, Foundry Co., Newark, N. J.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson, J. W. Co., Philadelphia.
Rockwell Engineering Co., New York.

Graphite:
United States Graphite Co., Philadelphia.

Grinding Machinery:
Adams Co., Dubuque, Ia.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Norton Co., Worcester.
Ransom Mfg. Co., Oshkosh, Wis.

Grinding Wheels:
Norton, Co., Worcester, Mass.

Hammers:
Independent Pneumatic Tool Co., Chicago.

Hammers (Pneumatic):
Chicago Pneumatic Tool Co., Chicago.

Hammers (Pneumatic Chipping):
Ingersoll-Rand Co., New York.

Heating & Ventilating Apparatus:
American Blower Co., Detroit.
Sturtevant, B. F. Co., Hyde Park, Mass.

Hoists:
Curtis & Co. Mfg. Co., St. Louis.
General Pneumatic Tool Co., Montour Falls, N. Y.
Harrington, Edwin, Son & Co., Philadelphia.
Niles-Bement-Pond Co., New York.
Northern Engrng. Works, Detroit.
Pawling & Harnischfeger, Milwaukee.
Sellers, William, & Co., Inc., Philadelphia.
Sturtevant, B. F. Co., Hyde Park, Mass.
Whiting Fdy. Equipment Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Hoists (Pneumatic):
Chicago Pneumatic Tool Co., Chicago.
Ridgway, Craig, & Son, Coatesville, Pa.

Hydrofluoric Acid:
General Chemical Co., Philadelphia.

Industrial Ry. Equipment:
Atlas Car & Mfg. Co., Cleveland.
Wiener, Ernst, Co., New York.
Wonham & Magor, New York.

Iron Ore:
Rogers, Brown & Co., Cincinnati.

Ladles:
Northern Engrng. Works, Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.

Magnets (Lifting):
Electric Controller & Supply Co., Cleveland.

Malleable Iron Melting Furnace:
Buffalo Furnace Works, Buffalo.

Molding Machines:
Adams Co., Dubuque, Ia.
Arcade Manufacturing Co., Freeport, Ill.
Berkshire Mfg. Co., Cleveland.
Bonvillain Ph. & E., Ronceray, Paris, France.
Herman Pneumatic Machine Co., Zelienople, Pa.
Manning, Maxwell & Moore, New York.
Maywood Foundry & Machine Co., New York.
Mitchell-Parks Mfg. Co., St. Louis.
Mumford, E. H. Co., Philadelphia.
Paxson, J. W. Co., Philadelphia.
Pridmore, Henry E., Chicago.
Rathbone, John A., Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.
Tabor Mfg. Co., Philadelphia.

Packing (Rubber Sheet):
Smooth-On Mfg. Co., Jersey City.

Parting Compounds:
Doggett, Stanley, New York.
Foundry Specialty Co., Cincinnati.
Partamol Co., New York.
Smyth, Swoboda & Co., New York City.

Pattern Letters:
Shanafelt Mfg. Co., Canton, O.

Patterns (Metal & Wood):
Herman Pneumatic Machine Co., Zelienople, Pa.

Pattern Shop Equipment:
Fox Machine Co., Grand Rapids, Mich.

Phosphorizers:
McCullough-Dalzell Crucible Co., Pittsburg.
New Era Mfg. Co., Kalamazoo.

Pig Iron:
Addy, Mathew, & Co., Cincinnati.
Baird & West, Detroit.
Bartlett, N. S. & Co., Boston.

Continued on page 122

Knowing where to look

The other day a little group of men sat at luncheon. Conversation happened to turn upon snails. One of the men was a conchologist—a life long student of shells—and to illustrate a point he picked up a bunch of watercress which garnished the roast, and immediately shook out two minute black snails. The cook who washed the cress didn't know they were there, nor did the man who was going to eat it. The conchologist didn't know they were there either, but he knew where to look for them.

The success of our costs methods rests largely on the capacity they have shown to uncover unsuspected sources of manufacturing loss and waste. By saving a cent here, a lost motion there, a duplication somewhere else, by shaking the snails out of the departments, they are constantly adding to the profits of manufacturers who sincerely believed they had reduced their business to the last notch of systematic efficiency.

May we have an interview?

Systematizing department

Library Bureau

316 Broadway, New York City

Cherry Valley Iron Co., Pittsburg.
Columbus Iron & Steel Co., Columbus.
De Camp Bros. & Yule, St. Louis.
Dimmick, J. K. & Co., Buffalo.
Domhoff & Joyce Co., Cincinnati.
Elliott, Debevoise & Anderson, New York.
Field, Robert, Sales Agency, Cincinnati.
Goodrich, F. A. & Co., Detroit.
Hillman, J. H. & Son, Pittsburg.
McKeefrey & Co., Leetonia, O.
Mohr, J. J., Philadelphia.
Nash, Isham & Co., New York.
Pickands, Brown & Co., Chicago.
Pickands, Mather & Co., Cleveland.
Pilling & Crane, Philadelphia.
Rogers, Brown & Co., Cincinnati.
Shepard, Chas. G., Buffalo.
Stevens, F. B., Detroit.
Thomas Furnace Co., Milwaukee.
Walter-Wallingford & Co., Cincinnati & Pittsburg.

Plumbago:

Gautier, J. H. & Co., Jersey City, N. J.
Hill & Griffith Co., Cincinnati.
McCullough-Dalzell Crucible Co., Pittsburg.
Obermayer, S. Co., Cincinnati.
Pettinos Bros., Bethlehem, Pa.
Ross-Tacony Crucible Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.
Stevens, F. B. Detroit.
United States Graphite Co., Philadelphia.

Polishers' & Platers' Supplies:

Stevens, F. B., Detroit.

Riddles:

Adams Co., Dubuque, Ia.

Sand:

Albany and No. River Molding Sand Co., Albany, N. Y.
Ballou's White Sand Co., Millington, Ill.
Newport Sand Bank Co., Newport, Ky.
Pangborn, Thos. W. Co., New York.
Paxson, J. W. Co., Philadelphia.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.

Sand Blast Machinery:

Drucklieb, C., New York.
Pangborn, Thos. W. Co., New York.
Paxson, J. W., Co., Philadelphia.
Tilghman-Brooksbank Sand Blast Co., Philadelphia.

Sand Mixing Machinery:

Falls Rivet & Machine Co., Cuyahoga Falls, O.
Mumford, F. H., Philadelphia.
Pangborn, Thos. W. Co., New York.
Sellers, William & Co., Inc., Philadelphia.
Standard Sand & Machine Co., Cleveland.
Stockham Homogeneous Mixer Mfg. Co., Piqua, O.

Sand Sifters:

Chicago Pneumatic Tool Co., Chicago.
Deane Steam Pump Co., Holyoke, Mass.
Hanna Engrng. Works, Chicago.
Herman Pneumatic Machine Co., Zelienople, Pa.
Standard Sand & Machine Co., Cleveland.

Saws (Cold Cutting):

Tabor Mfg. Co., Philadelphia.

Seacoal:

Hill & Griffith Co., Cincinnati.
Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.

Separators (Magnetic):

Dings Electro Magnetic Sep. Co., Milwaukee.
Elm City Engineering Co., New Haven.
Pangborn, Thos. W. Co., New York.

Shafting (Flexible):

Stow Mfg. Co., Binghamton, N. Y.

Shop Equipment:

Mfg. Equipment & Engineering Co., East Boston, Mass.

Shovels:

Stevens, F. B., Detroit.

Sprue Cutters:

Barnett, Oscar, Fdy. Co., Newark.
Shuster, F. B. Co., New Haven.
Middleditch, Benj., Detroit.

Stoppers:

McCullough-Dalzell Crucible Co., Pittsburg.
Ross-Tacony Crucible Co., Philadelphia.
Taylor, Robert J., Inc., Philadelphia.

Stove Trimmings:

Burdick & Son, Albany, N. Y.

Testing Machines:

Keep, W. J., Detroit.

Thermit Process:

Goldschmidt Thermit Co., New York.

Tools (Molders'):

Dobson, William, Canastota, N. Y.
Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.

Tools (Pneumatic):

Chicago Pneumatic Tool Co., Chicago.
Independent Pneumatic Tool Co., Chicago.

Tramrail Systems:

Randall, R. T. & Co., Philadelphia.

Trolleys:

General Pneumatic Tool Co., Montour Falls, N. Y.

Tumbling Mills:

Adams Co., Dubuque, Ia.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Gilmour, J., New York.
Sly, W. W., Mfg. Co., Cleveland.
Smith, J. D., Foundry Supply Co., Cleveland.

Twyers, Cupola:

Watt Cupola Twyer Co., Barnesville, Ohio.

Wire Straighteners:

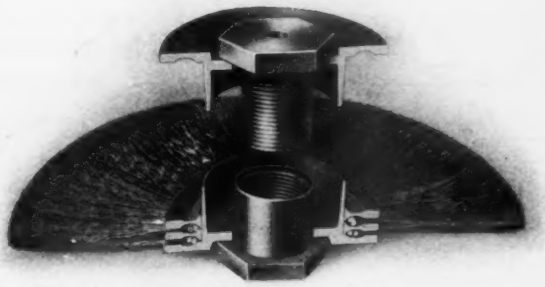
Blake, Geo. F., Mfg. Co., New York City.
Shuster, F. B. Co., New Haven.

Economy Steel Wire Wheel Brush

Operated on an ordinary emery grinder.

The use of an "Economy" means the saving of time and money, and better finished product in almost every plant where metal articles are made.

One man with an "Economy" will do more and better work than five men by other methods.



Sectional View Showing Construction.

The Hub is made of malleable iron and consists of a pair of Face Plates with connecting sleeve nut in the center. The wire part or brush proper, is made in sections each section being held in position by a malleable dividing ring.

Hub can be refilled with new sections very easily and by any one.

THE OSBORN MANUFACTURING CO.

CLEVELAND, O.

ESTABLISHED 1875.

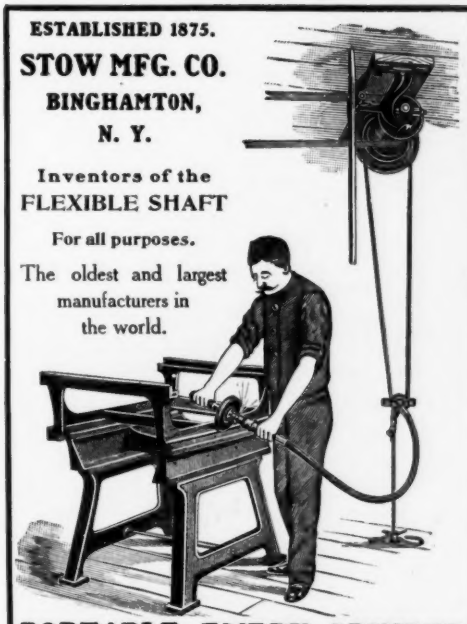
STOW MFG. CO.

BINGHAMTON, N. Y.

Inventors of the FLEXIBLE SHAFT

For all purposes.

The oldest and largest manufacturers in the world.



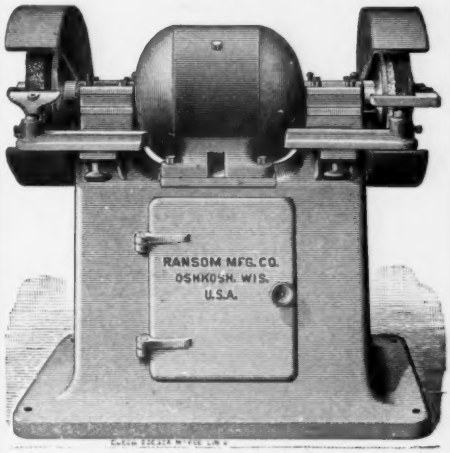
PORTABLE EMERY GRINDER

Take the tool to the work and save heavy handling.

Write us for Catalogue and Prices.

General European Agents: Messrs. Selig, Bonnenthal & Co., 85 Queen Victoria St., London, Eng.

MOTOR DRIVEN DRY GRINDERS



BIG SAVING

RANSOM MFG. CO.

OSHKOSH - - - WIS.

CLASSIFIED ADVERTISEMENTS

Wanted and For Sale advertisements 40 cents a line. Positions and Help Wanted 25 cents a line. Count seven words to the line.

PROPERTY FOR SALE

JOBBING IRON AND BRASS FOUNDRY for sale, located in western Pennsylvania. Price $6,000. Address Box 910, THE FOUNDRY, Cleveland, Ohio.

FOUNDRY IN FIRST-CLASS CONDITION for sale. For further particulars address Jules A. Desjardins, Rigaud, Que., Can.

JOBBING FOUNDRY INCLUDING FULL EQUIPMENT and at present in operation with established business. Paying well. Positively good reasons for selling. Reliable Foundry & Machine Co., Quincy, Ill.

FOUNDRY AND MACHINE SHOP FOR SALE as a growing concern, in fast growing city of Western Canada. Splendid location for building up a large business. This is an A-1 proposition. Address Box 883, THE FOUNDRY, Cleveland, O.

SMALL JOBBING FOUNDRY FOR SALE, adjacent to two railroads, having switch from one into yard, in the best town in Iowa, Waterloo. Ill health of owner reason for selling. A snap for some one. Address Box 884 THE FOUNDRY, Cleveland, O.

A COMPLETELY EQUIPPED BRASS FOUNDRY and Machine Shop for the manufacture of Plumbers' goods. A splendid line of patterns and new machinery and tools. Trade well established. Situated where there are no labor troubles and within 100 miles from Chicago. Address Box 814, THE FOUNDRY, Cleveland, Ohio.

CUPOLAS, ETC., FOR SALE

TWO SECOND-HAND CUPOLAS IN FIRST-CLASS condition. Shells 72"-82" in diameter and about 40 feet high. Box 800, THE FOUNDRY, Cleveland, Ohio.

ONE SECOND-HAND CUPOLA in first-class condition for sale, capacity 4 to 5 tons per hour, diameter of shell 48", diameter inside of lining 34", total height 72', complete with lining. Can be seen at our shops in position. Address Ames Iron Works, Oswego, N. Y.

FOR SALE, MISCELLANEOUS

FLUOR SPAR.—Every grade. Quotations delivered anywhere. Cheapest suppliers. Address GEO. G. BLACKWELL SONS & CO., Ltd., Liverpool, Eng., or Agents Penna. Salt Mfg. Co., Pittsburg, Pa.

ONE CLEVELAND SAND MIXER in A-1 condition for sale. The Gardner Governor Co., Quincy, Ill.

NEW ADAMS MOLDING MACHINE 60-in. size, cost $95.00. Will sell for $65.00 cash Chicago. William R. Perrin & Co., Loomis and 46th streets, Chicago, Ill.

BLOWER BARGAINS.
Roots Second-Hand Blowers, bought, sold or exchanged for new ones. Address,
H. M. PAPWORTH,
120-122 Liberty Street, New York City.

HARDWARE SPECIALTY BUSINESS, together with patterns, jigs, etc., for sale. Grand opportunity for anyone who has foundry or space in foundry. Costs little to manufacture and profits big. Good reasons for selling. It will pay anyone interested to investigate. Address Box 901, THE FOUNDRY, Cleveland, Ohio.

SIX HUNDRED TONS NO. 2 FOUNDRY IRON. Delivery two hundred tons each month February, March and April. For analysis and price, address Box 870, THE FOUNDRY, Cleveland, Ohio.

One 6-ton Jib Crane with mast 20 feet high, Jib 18 feet long.
One 1200-lb. Ball drop weight.
One 1800-lb. Ball drop weight.
William R. Perrin & Co., Loomis & 46th streets, Chicago, Ill.

PULLEY MACHINES FOR SALE
2 No. 1
2 No. 2
1 No. 3
1 No. 4
with single and double belt patterns ranging from 6" to 48" and arms and hubs to suit.
All machines and patterns in first-class condition, also 40,000-lb. Iron Flasks for various size pulleys. Davison Foundry Co., E. Chicago, Ind.

PATTERNS FOR SALE

CAST IRON TOY PATTERNS. Complete, up-to-date line. All gated and in excellent condition. Also several thousand dollars' worth of orders and sales included. Increase other lines compels us to discontinue toys. Address Box 866, THE FOUNDRY, Cleveland, Ohio.

WANTED MISCELLANEOUS

FOUNDRY EQUIPMENT WANTED.—Cupola (6 to 10 tons), and equipment for small Stove plate foundry. Location near Chicago. Address Box 856, THE FOUNDRY, Cleveland, Ohio.

A NEW YORK CONCERN DESIRES THE SALES AGENCY of Machinery or Specialties for foundry, mill or contractors' use. Success in selling insured by up-to-date methods. Address Box 877 THE FOUNDRY, Cleveland, O.

SECOND-HAND FOUNDRY EQUIPMENT WANTED, including Cupolas, Ladles, Tumbling Barrels, etc. Quote price and state condition. Address Box 885, THE FOUNDRY, Cleveland, O.

BUSINESS OPPORTUNITY. Would purchase, with cash, active control of good manufacturing, established business in the East. Must be sound and staple requiring investment of $20,000 or over. Iron Founders take notice. Principals only. Address Box 876, THE FOUNDRY, Cleveland, Ohio.

INDUSTRIAL LOCATION

ST. JOSEPH, MO., HAS SPLENDID OPENINGS for additional gray iron foundries, for malleable iron foundry and for general machine works. Cheap Coal, Natural Gas at low cost, reasonable labor, low taxation and satisfactory banking. Unsurpassed territory. Address H. G. Krake, Commissioner, Business Men's League, for particulars.

SALESMAN WANTED

SALESMAN FOR JOBBING BRASS FOUNDRY in the East, on small castings, a hustler who knows the trade and is capable of making prices. One who could handle it as a side line preferred. Address Box 867, THE FOUNDRY, Cleveland, Ohio.

SALESMAN WANTED, by large foundry, to sell gray iron castings and for engine and machine work, also for cement plants, in States of Pennsylvania, New Jersey and New York. State previous experience and salary required. Address Box 889, THE FOUNDRY, Cleveland, O.

MOLDERS WANTED

FIRST CLASS PATTERN MOLDERS wanted to work upon making iron water heater patterns from the wood, strictly open shop, and best wages paid. Call on or write at once to Abendroth Brothers, Port Chester, Westchester Co., N. Y.

EXPERIENCED MOLDER WANTED to take charge of a small foundry in Ohio, making agricultural implement castings. Open shop. Must be capable to manage the foundry. Address Box 887, THE FOUNDRY, Cleveland, O.

AT ONCE eight first-class, all-round green-sand, non-union molders, accustomed to medium floor work, pieces weighing 100 to 1,500 lbs. each. Only sober, industrious molders, with good recommendations need apply. We want steady men, and will guarantee a year's job to molders who make good. No trouble in the shop. Non-union shop for three years. Address Box 902, THE FOUNDRY, Cleveland, Ohio.

FOUNDRY FOREMAN WANTED

FOREMAN WANTED to take charge of foundry in Nova Scotia, for the manufacture of hot water boilers and radiators. State experience and salary wanted. Address Box 900, THE FOUNDRY, Cleveland, Ohio.

COMPETENT ASSISTANT TO GENERAL FOREMAN wanted in foundry employing 75 molders on high-grade work. Splendid opportunity for a young or middle-aged man. Address Box 898, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN. Wanted an experienced practical foundry foreman in a large establishment doing work of miscellaneous character. Address by letter with references Box 907, THE FOUNDRY, Cleveland, O.

FOREMAN FOR OPEN SHOP wanted, foundry employing about 15 men near New York, making machinery castings up to three tons. Permanent position to capable and reliable man, and only such need apply, giving reference, age and salary wanted. Address Box 888, THE FOUNDRY, Cleveland, O.

FOREMAN FOR FOUNDRY ON PUGET SOUND. Young man preferred. Must understand handling of men and ability to show results. Saw mill and general machinery. Twenty to thirty molders employed. No labor troubles. Good opening for proper man. Address Box 848, THE FOUNDRY, Cleveland, Ohio.

A FIRST CLASS FOUNDRY FOREMAN, for iron foundry employing several hundred men on heavy and medium work. Must be a practical, energetic man, capable of organizing and handling a foundry in all its details, only men holding similar positions need apply. State experience, age, nationality and present salary. Address Box 904, THE FOUNDRY, Cleveland, O.

GENERAL FOREMAN for gray iron foundry in East employing 100 molders and coremakers. Must be good on rigging and up-to-date in modern methods. Liberal treatment to a progressive and energetic man. State Age, Experience, references, full records, previous service, and minimum salary acceptable until ability is demonstrated. Answer in detail. Hapgoods, 305 Broadway, N. Y.

ASSISTANT FOREMAN WANTED for shop making medium sized steel castings. Address Box 909, THE FOUNDRY, Cleveland, Ohio.

A SOBER, INDUSTRIOUS WORKING FOREMAN for small foundry. Small Mining Camp, Central California. Good wages—no labor troubles. Steady position for right man. State age, experience, references. Box 854, THE FOUNDRY, Cleveland.

FOUNDRY FOREMAN. A young married man as general foreman or assistant superintendent in a new modern foundry doing high-grade work. This is a splendid opportunity for a strictly reliable man who is looking for a permanent position in one of the best located cities in the U. S. None need apply who have not held good positions and received good salaries. Company now employing over 700 men. No labor troubles. Write stating experience fully, salary expected. Address Box 891, THE FOUNDRY, Cleveland, O.

PATTERNSHOP HELP WANTED

PATTERN MAKER WORKING FOREMAN, small shop, eastern city. Chance for right man to grow. State age, experience and pay expected. Address Box 865, THE FOUNDRY, Cleveland, Ohio.

FIRST-CLASS, ALL-ROUND PATTERN MAKER and Mechanical Draftsman, wanted, who can appreciate a good position with ample opportunities of advancement. Address Box 911, THE FOUNDRY, Cleveland, Ohio.

CORE ROOM HELP WANTED

ASSISTANT FOREMAN OF CORE MAKING DEPARTMENT wanted, high-grade steam engine work. Excellent opportunity for an ambitious young man. Address Box 899, THE FOUNDRY, Cleveland, O.

FOREMAN FOR CORE ROOM employing 12 men on agricultural implements. Must be strictly up-to-date in making different core mixtures and establishing piece-work prices. Non-union. State age, experience, references and wages expected. Address Box 859, THE FOUNDRY, Cleveland, Ohio.

SUPERINTENDENT WANTED

A SUPERINTENDENT WANTED by one of the largest Steel Foundries in the country. Only men of experience need apply. Give experiences and full particulars. Address Box 883, THE FOUNDRY, Cleveland, Ohio.

SUPERINTENDENT, MALLEABLE FOUNDRY, for a new plant about to be erected in Canada associated with one of the largest and most successful industries in the country.

Applicants must be possessed of good executive ability, conversant with all details of erection and management, formulas and mixtures and be prepared to start with a moderate salary at first.

Plant will be small at first and increase as occasion demands. Applicants may invest in stock of the Company if they choose. Apply Box 908, THE FOUNDRY, Cleveland, Ohio.

FOUNDRY SUPERINTENDENT WANTED for plant making light Gray Iron Castings. Must have ability to take entire charge of works employing 250 men. A good opportunity for right man. State fully age, experience and salary expected. Address Box 892, THE FOUNDRY, Cleveland, O.

HELP WANTED, MISCELLANEOUS

UP-TO-DATE MANAGER WANTED for a moderate sized foundry now under construction. One who has been a successful foundry foreman preferred. Address Box 890, THE FOUNDRY, Cleveland, O.

PLUMBAGO GRINDER WANTED. Practical experienced man who can produce results economically can secure good position in the East with liberal arrangement. Replies treated confidentially. Address Box 886, THE FOUNDRY, Cleveland, O.

COMPETENT FOREMEN OF BRASS FINISHING ROOM wanted for concerns in Pennsylvania and Massachusetts; must be experienced, aggressive men, familiar with all up-to-date methods; salaries, $1,200-$1,800. Hapgoods, 305 Broadway, New York.

AN OPEN SHOP FOUNDRY IN EASTERN PENNSYLVANIA, making gray iron castings for Steam Specialties, desires to engage a man having experience with different kinds of molding machines, and who is competent to attend to the making or altering of patterns for the machines, and to instruct men in operating same. Address with full particulars as to experience and references. Box 873, THE FOUNDRY, Cleveland, Ohio.

SUPERINTENDENTS WANT POSITIONS

STEEL FOUNDRY SUPERINTENDENT open for engagement with reliable firm. Sound experience in general foundry work, also pattern making. Competent and capable of supervising work from start to finish. Address Box 903, THE FOUNDRY, Cleveland, Ohio.

FOUNDRY SUPERINTENDENT would like a change. Has had 10 years' experience as a foreman and Superintendent. A practical molder. Would prefer corresponding with radiator or boiler people as most of my experience has been with this product. Address Box 905, THE FOUNDRY, Cleveland, Ohio.

POSITION AS SUPERINTENDENT or general foreman wanted by a practical foundryman. 33 years' experience in the foundry business. At present superintendent of a steel and iron foundry using converter. Malleable or steel foundry preferred. Address Box 912, THE FOUNDRY, Cleveland, Ohio.

SUPERINTENDENT: Young man, energetic, aggressive; familiar with construction of jigs, tools and fixtures for production of interchangeable parts, up-to-date methods of handling help and getting work out rapidly and at small cost of production. At present with concern making and finishing both brass and iron castings. Will be at liberty in a few weeks. Address Box 906, THE FOUNDRY, Cleveland, Ohio.

ARCHITECTURAL AND ORNAMENTAL WORK foreman patternmaker seeks a change. Would like position as superintendent or general foreman. Has wide experience in this line of work; capable of handling large force of men and supervising work from start to finish; up-to-date in modern foundry practices and molding machines; character and ability will bear strictest investigation. 25 years' experience. Address Box 913, THE FOUNDRY, Cleveland, Ohio.

POSITION AS FOUNDRY MANAGER OR SUPERINTENDENT wanted by a young man with 15 years' experience on extremely heavy loam and light green sand castings. Thoroughly practical on all types of molding machines and up-to-date on foundry appliances; also familiar with the very best methods of metal pattern work. Have mechanical education and have traveled considerably. Will not consider a small shop or cheap job. Address Box 875, THE FOUNDRY, Cleveland, Ohio.

POSITION AS SUPERINTENDENT OR GENERAL FOREMAN wanted in a malleable iron foundry. Successful in handling men with good results. Up-to-date, good mixer and A. No. 1 reference. Address Box 893, THE FOUNDRY, Cleveland, O.

POSITION AS SUPERINTENDENT OR MANAGER in foundry, wanted, by a competent man, well up in small and medium-sized work, annealed and soft castings and general tool and engine work. Experienced in mixing metals for all grades of work. Thoroughly commercial and able to manage a plant profitably. Address Box 896, THE FOUNDRY, Cleveland, O.

FOREMANSHIP WANTED

POSITION AS FOREMAN wanted by first-class foundryman with good executive ability on light or heavy work. Address Box 810, THE FOUNDRY, Cleveland, Ohio.

POSITION AS GENERAL FOREMAN wanted. Have twenty ears' experience in Gray Iron; five years in Malleable Iron. Can handle molding machines successfully. Furnish first-class reference. Address Box 895, THE FOUNDRY, Cleveland, O.

POSITIONS WANTED, MISCELLANEOUS

POSITION WANTED by practical foundryman, 22 years' experience in Modern Foundry Practice. A1 references as to character and ability. Address Box 894, THE FOUNDRY, Cleveland, Ohio.

POSITION WANTED. Efficient, trustworthy young man would take complete charge of small foundry. Several years' experience, reference both as to character and ability. Address Box 897, THE FOUNDRY, Cleveland, O.

The Injector Sand Blast Apparatus.

If Interested in Efficient, Quick, and economical Cleaning of Castings, Write for Circular to

C. DRUCKLIEB,

132 Reade St., New York.